MACHINERY.

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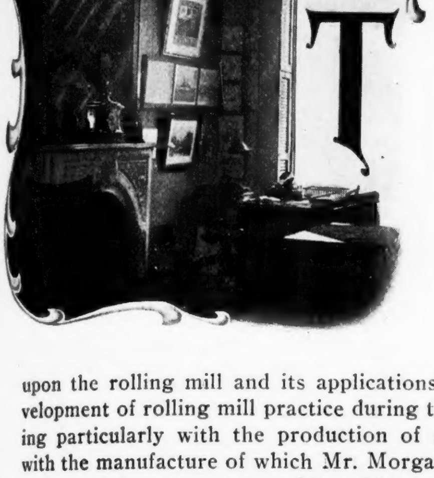
THE NEW YORK MEETING OF THE A. S. M. E.



THE forty-second meeting of the American Society of Mechanical Engineers opened on Tuesday evening, December 4, at the society house, 12 West Thirty-first street, New York, with the usual address of the president and a social time for the members.

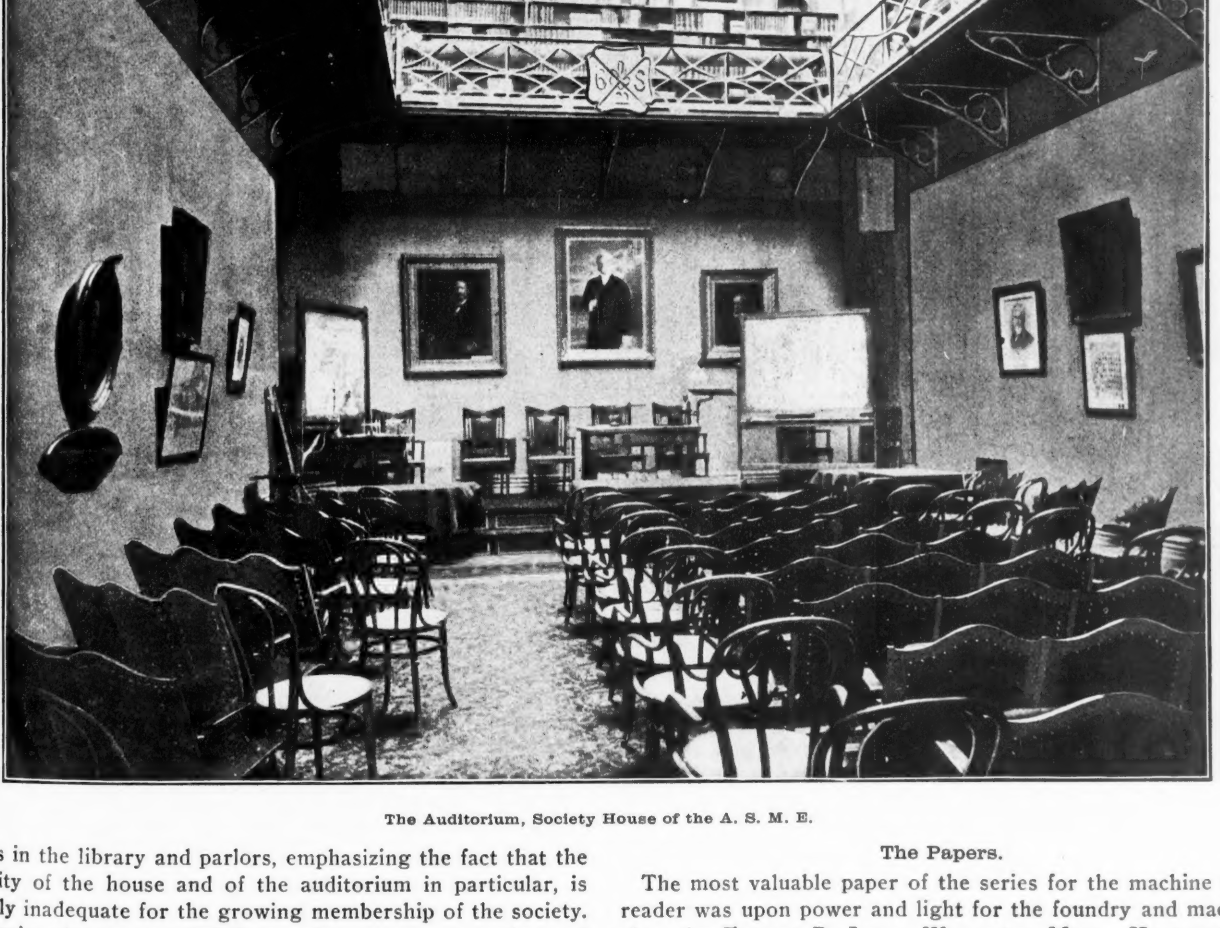
The retiring president, Chas. H. Morgan, spoke in his address upon the rolling mill and its applications. He traced the development of rolling mill practice during the past century, dealing particularly with the production of small bars and wire, with the manufacture of which Mr. Morgan has been intimately connected for many years. The address was listened to by an audience which packed the auditorium and there were many others in the library and parlors, emphasizing the fact that the capacity of the house and of the auditorium in particular, is entirely inadequate for the growing membership of the society. Otherwise the present building makes a very attractive and satisfactory home, as attested by views of the various rooms shown in connection with this report.

On Wednesday morning the regular business was transacted and reports of committees read. The tellers announced the election of the following officers:

President, Samuel T. Wellman, Cleveland, O.; Vice-Presidents, Arthur M. Waitt, New York City, James M. Dodge, Philadelphia, and Ambrose Swasey, Cleveland; Managers, W. F. M. Goss, Lafayette, Ind., De Courcy May, Scranton, Pa., and D. S. Jacobus, Hoboken, N. J.; Treasurer, William H. Wiley, New York City.

Of the various committee reports, that upon engine tests stated that the committee had completed their code for steam engine trials, but had yet to complete the details for gas engine tests and would not be ready to report until the spring meeting. The committee on standards for electric generating sets, also were not able to report.

Following the business came the papers allotted to Wednesday morning and the balance of the business sessions were devoted to reading and discussing the papers, a brief statement of the contents of which will be found in what follows. The only deviation from the regular order was one session held at Columbia University, where members were entertained by examining the new laboratories and buildings of the University. The social event, the reception at Sherry's, was largely attended and counted by all an unusually pleasant affair.



The Auditorium, Society House of the A. S. M. E.

The Papers.

The most valuable paper of the series for the machine shop reader was upon power and light for the foundry and machine shop, by Forrest R. Jones, Worcester, Mass. He presented various considerations that should enter into the equipment of a shop with electric power for light and heat and con-

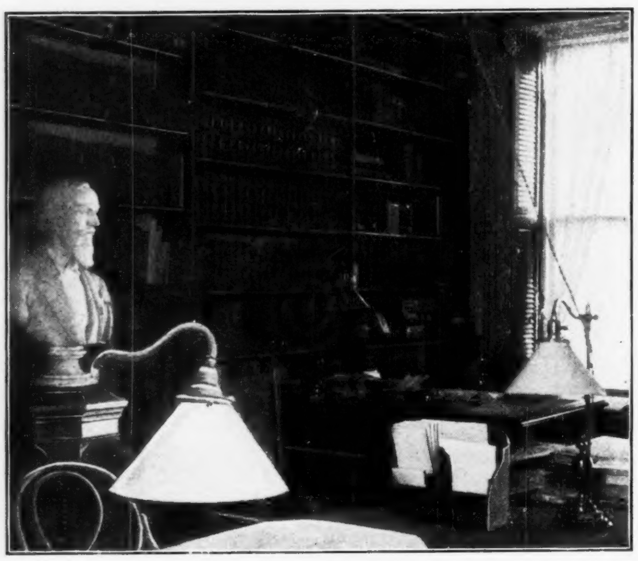
cluded that the direct current of 220 volts for the majority of motors and 110 volts for arc and incandescent lamps was suitable for average shop conditions.

To obtain information as to the amount of power required to drive different machines, tests were made upon groups, individual machines, sections of shafting, cranes and elevators. The power for a number of unusual conditions was noted, such as, for example, to drive a 48-inch lathe in polishing work at high speed, where seven horse power was absorbed, or much more than would ordinarily be required. A number of planers were tested showing that the power necessary to reverse them

View of Balcony, in the Auditorium.

when loaded with work was more than enough to drive them during the cutting stroke.

Three 30-ton electric cranes were tested, showing that over 300 amperes were necessary when carrying a load of 20 tons and two or more crane motions were started simultaneously, while but one-third of this was necessary for hoisting a 20-ton load directly at 10 feet a minute. A worm-operated elevator that should not consume more than five horse power under good conditions required at times as high as 20 horse power, indicating what may be expected from worm gearing when not properly adjusted and lubricated. Several other interesting



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power determinations were given and the whole paper will repay careful study on the part of those interested in power for the machine shop.

One of the most important papers of the meeting was by C. E. Sargent, Chicago, an expert in gas engine work, upon a new principle in gas engine design. The feature of the new design is a method of introducing the charge into the cylinder by which it can be economically expanded to nearly atmospheric pressure, instead of exhausting at 30 or 40 pounds above the atmosphere, as with the usual Otto-type engine. In the latter, after the scavengering stroke which removes the burned gases from the cylinder, the charge of gas and air is drawn into the cylinder during one full stroke of the piston. It is then compressed during the return stroke and fired during the next forward stroke, which thus gives an impulse to the piston during every fourth stroke. In this type the engine is usually governed by the hit-and-miss plan of either admitting the charge or not, as required, or else by throttling. In the Sargent engine, the governing is effected by admitting only as much of the mixture at any time as is required to keep the speed of the engine constant. Thus, instead of drawing in the charge during a full stroke, it is drawn in, perhaps during half stroke, and then the supply is cut off, just as steam is cut off in the engine cylinder. During the balance of the stroke, the gas expands to below atmospheric pressure; on the return its pressure gradually rises again and it is finally compressed. At the beginning of the next stroke, the charge is ignited, and expands to a low pressure, due to the fact that it is expanding throughout the full stroke of the engine, while the charge was admitted through only part of one stroke, thus making the total quantity admitted smaller than usual. A high economy and close regulation are claimed for this construction, and the low average temperature in the cylinder has made possible the use of a double-acting tandem design for the engine, giving an impulse at every stroke, and thus reducing the size of the engine considerably. The author has also worked out a simple starting

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arrangement whereby by turning the engine over part of one revolution a sufficient charge is introduced to start the machine, the cycle under which the engine works during starting being similar to that of the old Lenoir engine. After it commences to run, the cycle is changed to that described above. It was stated in the discussion that graphite was employed with success for lubricating the piston rod.

Dr. Robert H. Thurston has at various times presented papers touching upon different aspects of steam economy, like high pressure steam, the use of reheaters, etc., that have been of great value. They have brought together such information as was available upon the subjects and have in a measure been a historical summary or resume of the particular subject treated. At this meeting he followed his custom in such matters of giving a comprehensive and extended paper upon the steam turbine. He traced the historical growth of the turbine, stated the principles of the modern steam turbine, its advantages, and described the Laval and Parsons wheels, the leading modern types. The paper concluded with quotations from tests upon turbines and a discussion of their efficiency.

W. J. Keep, Detroit, Mich., has devoted much attention to testing cast-iron and has devised several forms of apparatus for this purpose. Among them is a specially arranged drill for comparing the hardness of metals, which he described in a paper upon the hardness or workability of metals. Keep's latest machine has a table with a vertical motion and with a test bar clamped to its upper surface over a ½-inch central opening which receives the point of the drill. The drill operates on the metal from underneath and the table is fed down

upon it by weights. The number of revolutions of the drill for a given depth drilled shows the hardness of the metal. An automatic recording instrument is attached, which draws a line the inclination of which shows the degree of progress made by the drill.

W. B. Gregory, New Orleans, La., reported tests upon two centrifugal pumps, one with two-inch discharge pipe and impeller 5.14 inches in diameter, while the other was a large drainage pump, 70 inches diameter, with discharge 48 inches diameter. The tests upon the small pump showed that there was a certain speed at which a pump would run most economically when pumping against a certain head, and that when this speed was increased, the efficiency would drop very rapidly. Previous to this speed of maximum efficiency the performance would increase with the speed. The tests of the large pump indicated that the efficiency decreased with increase in speed, contrary to the results with the small pump, indicating that there is need of further experiments in this direction.

Carlton A. Read, Durham, N. H., prepared a paper describing an apparatus for testing indicator springs and indicators while the instruments were running under substantially the same conditions as when in actual use. It is well known that tests of indicators by direct pressure show results varying by a small per cent. from those produced when the indicator is running. Two years ago were published in the columns of MACHINERY descriptions of numerous indicator testing devices, one of which was a dynamic tester, the invention of Profs. Peabody and Miller, of the Mass. Institute of Technology, which is quite similar to the one now described by Mr. Read. Readers who have this copy of the paper will there find a brief description of this form of apparatus.

The Willans steam engine holds about the same position in England as the Westinghouse engine in America. It is an English product and has found much favor in that country, but has not been popular here. Its features are single-acting cylinders, one above the other, making a compound or triple engine as desired. The piston rod of the engine is hollow and has openings into the cylinders. A series of piston valves operate inside of the piston rod, opening or closing the ports at the correct times. What is called an American Central Valve Engine has been designed by E. T. Adams, Milwaukee, Wis., and this formed the subject of a paper. In this engine a trunk piston is used and the valve operates inside the trunk of the piston.

A year ago Mr. Kerr's paper describing the power plant of the South Station, at Boston, Mass., in which the mechanical engineering features were described was found of unusual interest by most of the members, and a wish was expressed that more papers of the same kind be presented. At the present meetings, Mr. F. W. Dean, Boston, gave a brief description of the power plant of the Massachusetts General Hospital, Boston, which has recently been installed. The plant has a number of features of interest to those having to do with the heating, lighting, and power of buildings.

Chas. T. Porter, the pioneer in high-speed engine work in this country, and the designer of the Porter weighted governor, contributed a valuable monograph of a historical character on the early period of high speed engineering, with special reference to the work of the late John F. Allen. His paper was not only of deep interest, but of historical value.

H. De B. Parsons, New York, called attention in a paper to the variations in the rules now in use for determining the strengths of the parts of a steam boiler, especially the various government and Board of Trade and similar rules. These rules are mostly of an empirical character and, as would be expected, they sometimes show a variation as great as 25 per cent., one from the other.

William Sangster, Boston, Mass., gave a few notes upon the design and use of fan blowers for forges and cupolas. The paper dealt mainly with the power required to drive fans and will prove of value to those having to estimate the power absorbed for such purposes.

One of the best papers was a report by W. F. M. Goss of an elaborate series of tests upon the boiler of the experimental locomotive at Purdue University, Lafayette, Ind. The tests show the evaporative performance, and observations were taken of various items pertaining to the coal, quality of steam, the steam blast, etc.

Three other papers were one by Wm. H. Bristol, Hoboken, N. J., describing a new recording air pyrometer for high temperatures; one by Max H. Wickhorst, Aurora, Ill., describing a mechanical integrator used in connection with a spring dynamometer; and one upon the construction of engineering and architectural contracts.

* * *

AMONG THE SHOPS.

THE NEW SHOPS OF THE WOODWARD & POWELL PLANER CO., WORCESTER, MASS.

Something more than one year ago, the Powell Planer Company was changed in name to that of the Woodward & Powell Planer Company, and at about the same time the building of new shops to accommodate the needs of their business was begun. The new building, now completed, is located on Webster Street, and is in a number of ways worthy of special mention.

The business of the company being exclusively the manufacture of planers, it is obvious that the new plant should have been primarily designed and built to generally facilitate the manufacture of heavy work, which has been done, and it has the important additional feature of being easily converted into a two-story building equally as well adapted for lighter manufacture, if such a contingency should ever arise.

The new shop being projected along modern lines with such features as a monitor roof, traveling crane, galleries, etc., the original plans not unnaturally called for a steel frame. This, however, for various reasons did not meet with approval, and as a result the shop was eventually built with a brick exterior and a heavy timber frame. The framework for the galleries is trussed in the same manner as certain forms of railway bridges, the elevation of one section showing the form of truss appearing in diagram B. The cross-section of the shop in diagram B shows the general dimensions and the arrangement of the galleries. There being also a gallery at the end, the side and end galleries are continuous and thus practically one. If it should ever occur that another class of manufacturing should be taken up of a lighter nature, making it desirable to have two floors, the space occupied by the traveling crane runway could very easily be floored over, and at small expense.

The width of the building is 87 feet and the length of the main portion 200 feet. The engine room and boiler house are continuous with the main building, and add 52 feet to the length, making a total of 252 feet. A railway switch from the adjacent tracks of the Boston & Albany Railroad allows cars to be run directly into the shop, for the unloading of supplies and the shipment of the finished product. The west end of the building, facing on Webster Street, is given up to the drafting room in the monitor. The general offices are just below, on a level with the shop galleries, and the coat and wash rooms, together with bicycle storage, are in the basement. The main floor of the shop extends to the street on one side only, the middle and other side being occupied by the stairways leading to the general offices and the basement, and also by an office for the general foreman. The general view of the building, taken from the B. & A. R. R. tracks, thus gives the impression of a three-story building with a monitor, but the basement extends only across the end and to the same depth as the offices above, the main shop floor thus being directly on the ground.

The offices are without doubt among the most handsomely appointed to be found in any building in the East devoted to the manufacture of machine tools, if not of any other business. The front or anteroom is shown in Fig. 7, and the private office in Fig. 6, page 144. Between these two rooms is the general office. The three rooms are all of generous size,

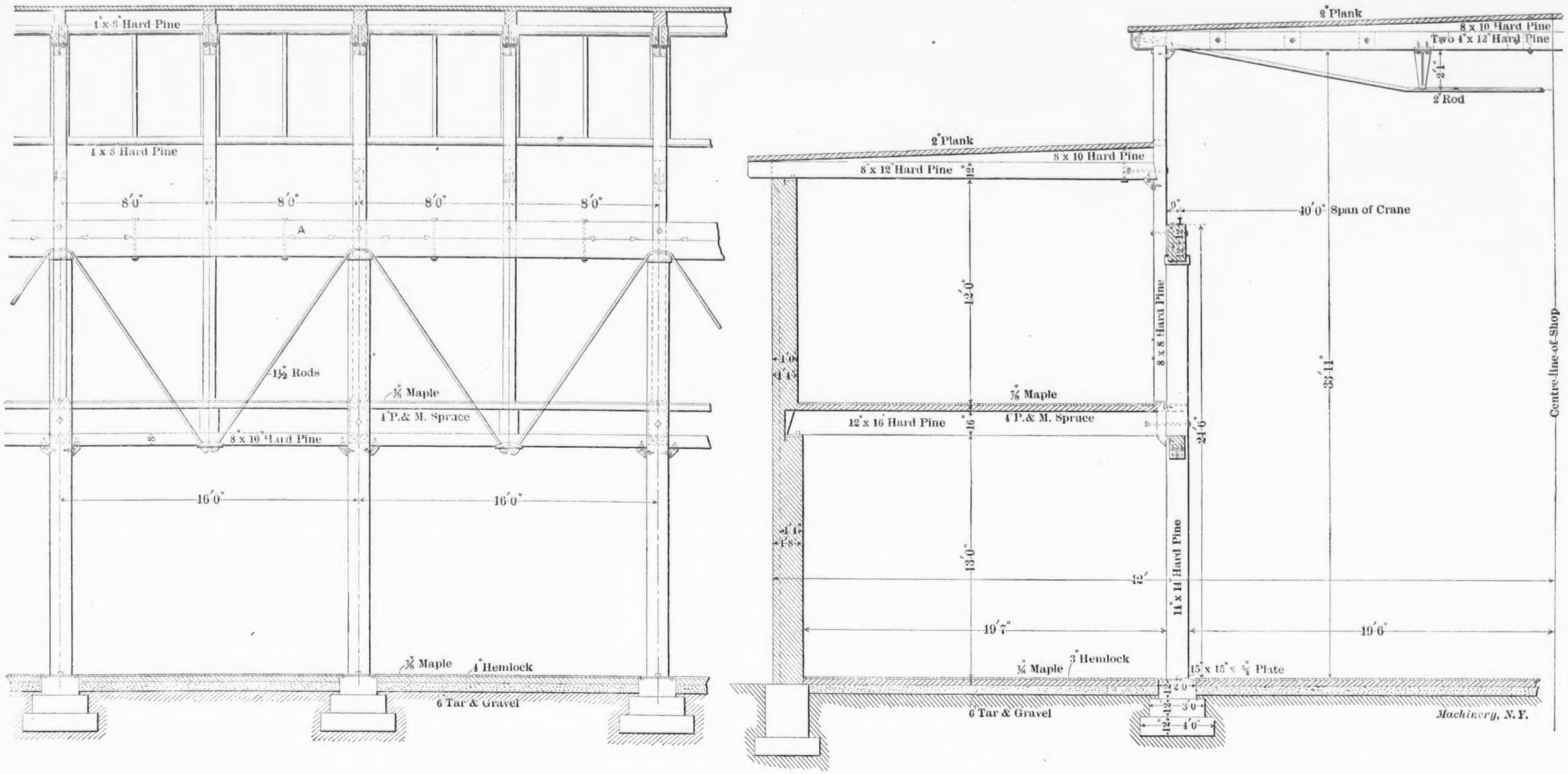


Diagram B. Side Elevation and Section of Woodward & Powell Shops.

occupying the full width of the building. The drafting room in the monitor includes the general conveniences of such a department and also a darkroom for photographing purposes.

In the shop, the galleries and the spaces under them naturally make divisions of the space. The south gallery is given up to the head work, which includes the crossrails and the elevating screws. Under the south gallery is what is known as the "running works" department. The space under the north gallery is the planer department and the gallery above is given up to the pattern shop, pattern storage and stock. The end gallery is generally left open for a passageway between the two side galleries and also for the convenience of the crane. The crane runway extends over the end gallery so that all work passing from one floor to the other is readily handled by the crane, thus doing away with the need for an elevator.

The shop is heated in winter by the exhaust steam from the engine, which, as it condenses, is again returned to the boilers. The exhaust steam passes through an oil separator before entering the heating system, and its circulation, with no back-pressure on the engine, is induced by a vacuum pump in the engine room. The steam not condensed in its travels is condensed by the injection of cold water from an artesian well and then pumped into a receiver to be again pumped into the boiler.

The line shaft is arranged in sections connected by belts and clutches so that any department may be run independent of the other by throwing the clutches of the departments not to be run, out of engagement.

The shop is superbly lighted, the light being diffused through glazed glass in the numerous windows in the monitor and sides. The glass is all glazed with the exception of the two lower rows of panes in the side windows. Drinking water is supplied to all parts of the shop from an artesian well something over 200 feet deep.

The shop floor consists of a top layer of ⅞" maple flooring laid on 3" hemlock plank. Under the planking is a 6" bed of

tar and gravel laid on a foundation of broken stone. The foundations for the posts were laid as indicated in the elevation, Diagram B. The tops of all of them were carefully leveled with a transit so that with all the posts could be cut to exactly the same length. The track for the crane is laid on 14" timbers, two on each side, one above the other, and with castings fitted between them as shown at point A, to prevent the wave action often noted in the tracks of traveling cranes when transporting heavy loads. The crane made by the Whiting Foundry Company has a capacity of ten tons, which, however, is only a nominal rating, the actual capacity being considerably more than ten tons, as has already been proved from actual experience.

Methods of Manufacture.

The manufacturer of milling machines naturally uses the milling machine wherever he can, both as an object lesson and because he honestly believes that this type of machine tool is well adapted to a great range of work. Whether the same spirit animates the policy of this firm in the manufacture of planers or not, it is obvious from a visit to their works that they thoroughly believe in the use of the planer for certain classes of work generally relegated to its rival, the milling machine. Thus the racks for the tables or platens have the gear teeth all planed to the shape of the cycloid rack tooth. The racks for the feed mechanism are also planed in the same manner as are the steel pinions meshing in the driving wheel. The teeth of the driving wheels are, however, milled in a gear cutter. The method employed in planing racks is interesting and is believed to be more accurate than milling and also cheaper in labor cost. A planer about 33" x 33" is used for the purpose, the

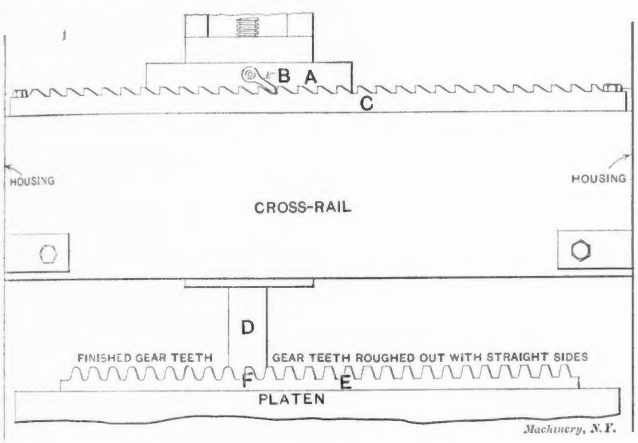


Diagram A.

racks being laid across the planer platen to its full capacity if need be. The teeth are roughed out by a double tool made by clamping two suitably shaped tools together with a distance piece between them. The spacing of the teeth is effected by a ratchet C secured to the top of the crossrail, as in Diagram A. A detent B on the head A drops into the successive notches, as the teeth are roughed out and the head moved along. The screw is reversed so as to bring the click hard against the adjacent tooth, when the head is moved along for each tooth. In this manner very accurate spacing is effected. After roughing, the teeth are finished singly by a double-toothed forming tool D, ground to the correct shape, after hardening. The forming tools are made by the Brown & Sharpe Mfg. Co. on their well-known principle of grinding without changing the form. Four ratchets are provided for the various pitches of driving racks and two for the feed racks. The changing of a ratchet is only a matter of removing the two tap bolts at the ends.

The steel pinions meshing in the driving gears also have their teeth cut on a planer. The pinion is made integral with the shaft, and its teeth cut to the cycloid form.

The driving gears are made of cast iron in which a certain percentage of steel chips has been incorporated just before being cast. These semi-steel gears are stronger than pure cast iron and have a close, even grain, making them peculiarly suited for the severe service of driving a planer platen.

All the feed and elevating screws are cut on a Blaisdell lathe. The elevating screws are laid away to "season" for some time, and then before being used are again put in the lathe and with a sharp side tool a thin chip is taken from the "lifting" side of the thread. In this manner very uniform results are obtained in the action of the two sides when raising a crossrail. The elevating screws are made of the same direction of lead and not opposite, as is the quite usual practice. They are operated by spiral gears from the cross shaft, thus making a neat arrangement which is nicely enclosed in a case at each side.

In the larger sizes of planers, ball bearings are put under the collars of the lifting screws, which by reducing the frictional resistance and the consequent torsional distortion of the screws, make the crossrails elevate easier and also keep the two ends more exactly at the same height than without them.

Planer Feed Arrangement.

The feed arrangement for the planer heads is quite simple and unique. By it each head can be fed right or left, independent of the other, and the slide in either head may be fed up or down while the other head is moving right or left. The feed may also take place at either end of the cut and with the same combinations. The mechanism is shown in Diagram C. There are two feed screws A and B, and the splined rod C for the vertical feed in the heads. The vertical feed rack J, driven from the friction box I, operates the shaft carrying the double-ended detents K, which are controlled by the knurled and flat thumb pieces L and M. The detents work inside of the internally and externally toothed gears E and F, one detent for each gear. The direction in which each gear will turn is controlled by the position of its detent relative to the internal teeth. The thumb pieces L and M will be seen to have two flat places milled on the sides of their spindles, against which the springs N N bear. With one flat in contact with the spring, the detent controlled will engage the internal teeth of its gear so as to operate it in, say, a right-hand direction, and, conversely, when in contact with the other flat, the wheel will be turned in a left-hand direction. To throw either gear out of action, the thumb piece controlling action of its detent is turned so that the notch P will engage the angle between the two flats and thus hold it out of engagement. It will thus be seen that with the intermediate pinions G and H in engagement with the pinions of the feed screws, the action of either head may be controlled entirely independent of the other by merely turning the thumb piece L or M. It will be observed that one thumb piece is round and knurled as L, while the other one, M, is flat-sided, which difference enables the operator to quickly distinguish between the two heads when controlling their action. It is obvious that with the intermediate gear in engagement with the pinion of the splined rod C, the action of the slide in either head is as readily controlled by the manipulation of the thumb pieces as in the case of the side feed. Of course, it is necessary in this case to throw the vertical feed into engagement in the head itself before it can be operated from the side. The position of the crank pin in the feed box determines whether the feed shall take place at the beginning or end of the cut, as is the usual practice. It is evident that the point at which the feed takes place is also determined by the direction of the feed. Thus with the feed taking place at the beginning of the cut when feeding—say to the left—it would take place at the end of the cut if the thumb piece be turned so as to feed to the right.

The heads are left unfinished except where machining is necessary. This makes a head that looks fully as well when new as when finished all over and much better when, as is usually the case, it eventually becomes covered with dried oil and gum.

The ends of the feed screws are not squared but are provided with a feather for the keyways in the crank handle. Four keyways are cut in the cranks, which thus allows them to be as readily slipped on to the shaft at any one of four angular positions as the squared shaft.

An arrangement (Diagram D) for grinding Gisholt lathe tools was noted in the tool room. A tool holder D is arranged to swing in the same plane as the wheel by being pivoted at C. A collar B is threaded on the supporting shaft which can be adjusted by hand so as to bring the tool against the face of the wheel. The tool is clamped on the holder as shown and is swung back and forth across the side of the wheel, thus grinding a straight cutting edge irrespective of the condition of the wheel. As the tool is ground away the Collar B is slacked back, which

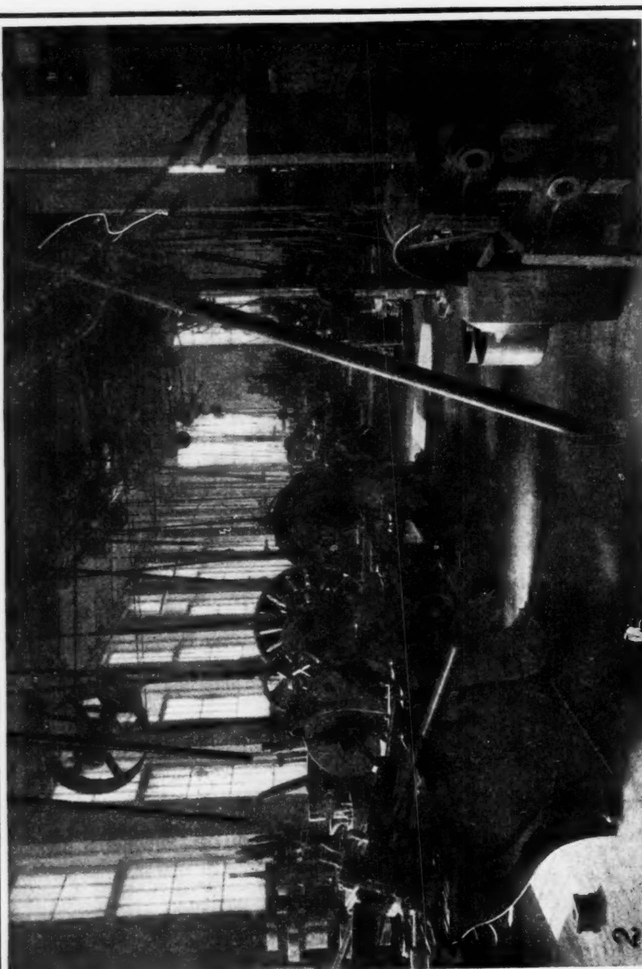
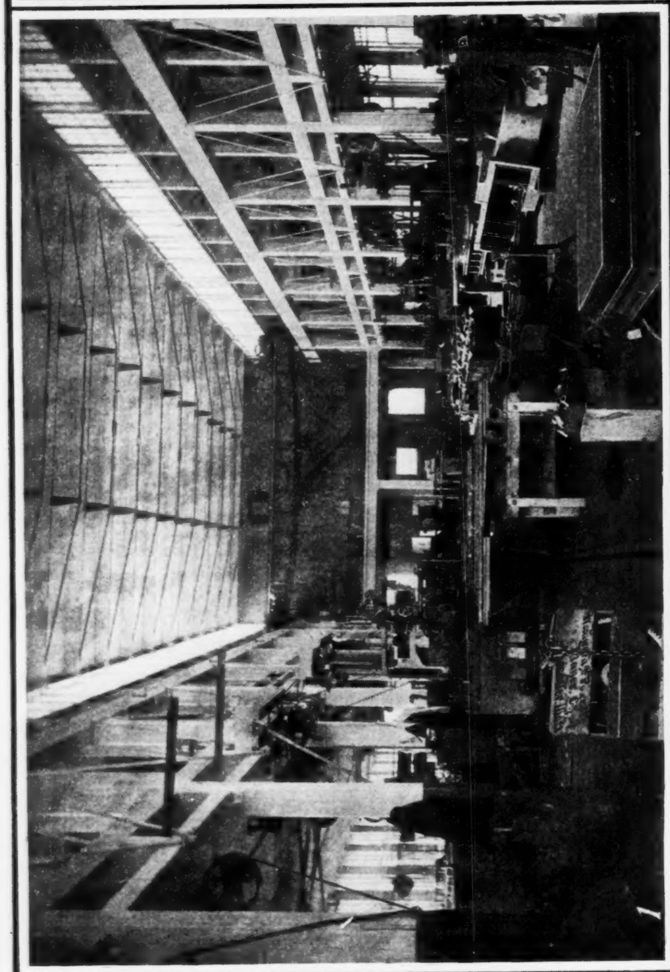


Fig. 2. Under South Gallery.
Fig. 4. Under North Gallery.



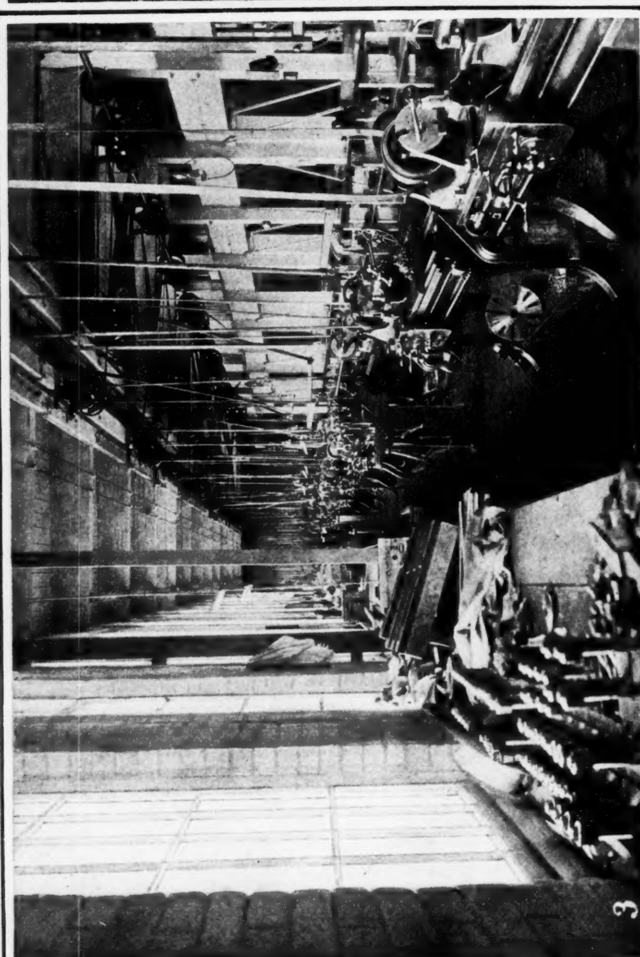


Fig. 1. Main Floor, Looking West.
Fig. 3. South Gallery, Looking West.

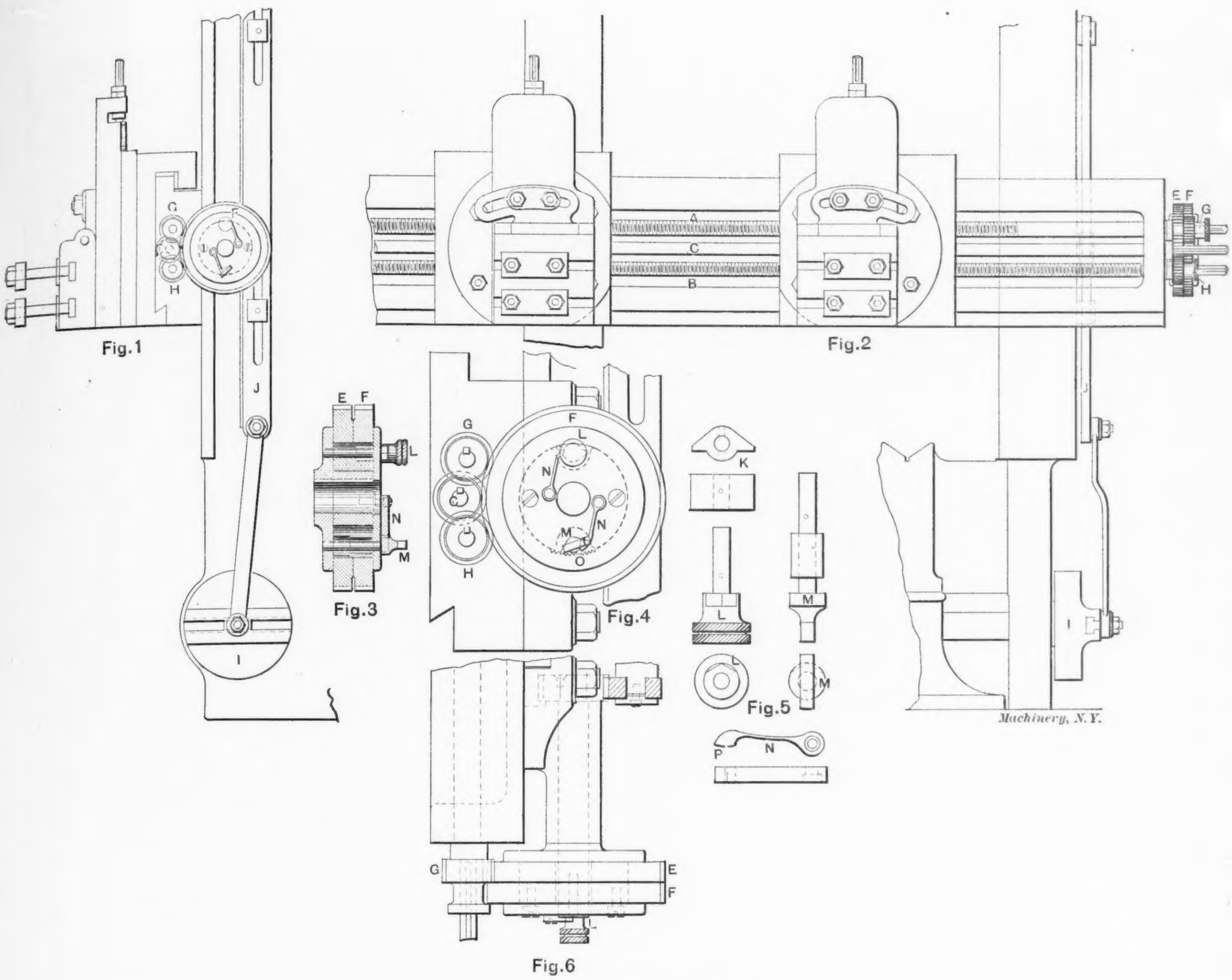


Diagram C. Planer Feed Mechanism.

allows the tool to be advanced against the wheel. It will be understood that the only force holding the tool against the wheel is the pressure given it by the operator in holding the collar against its bearing.

Shop System.

Castings and other materials are furnished to the shop on lot, stock and job orders, and also on "shop expense" orders for repairs. Careful accounting of all labor and material costs is the basis of the system. An inventory is made each month by which is known exactly how the firm stands, what its profits or losses have been, the stock and finished product on hand, and in short a complete synopsis of the financial condition is made monthly as well as yearly. The method by which this desirable result is obtained is comparatively simple and requires a minimum of clerical work to carry it out. A full account of it cannot be given without illustrating it with the various orders and tickets employed, but it may be briefly outlined.

The principal item in manufacturing is, of course, the cost of material and of producing labor. By producing labor is meant the labor that is directly employed on the work itself and not that of foremen, stock keepers, sweepers, etc. The latter items come under "unaccounted" labor and its percentage of the first two items is found by dividing the total cost of "unaccounted" labor by the total cost of materials and producing labor. The sum of the cost of materials, producing labor cost, and unaccounted labor cost is the net manufacturing cost outside of the office expenses, taxes, advertising, draftsmen, pattern making, depreciation, etc. The sum of these items divided by the manufacturing cost gives the percentage of "running expense" to be added to the manufacturing cost of any product to get the total cost. The total cost plus the selling profit constitutes the theoretical selling price. In this system nothing is left to guess work. Every tool bears (when sold at a profit) its actual manufacturing cost plus its equitable share of the inevitable expenses that must accompany any manufacturing enterprise. The profit must always be a somewhat vaying item, depending on the various commercial conditions existing at the time. The system is elastic, without which no shop system can be very successful, and readily adapts itself to those various contingencies that are always arising in manufacturing.

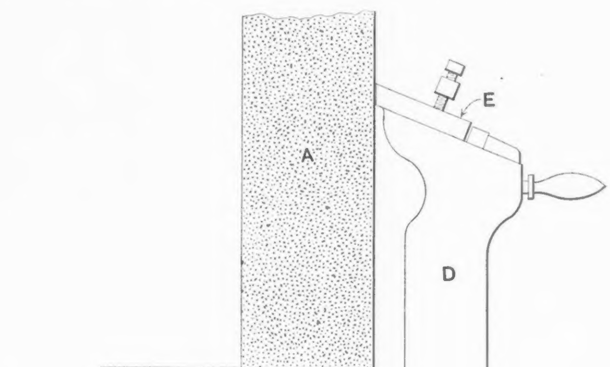
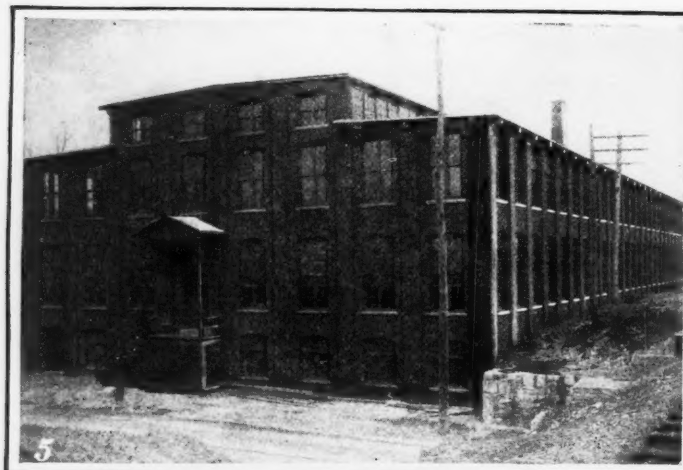
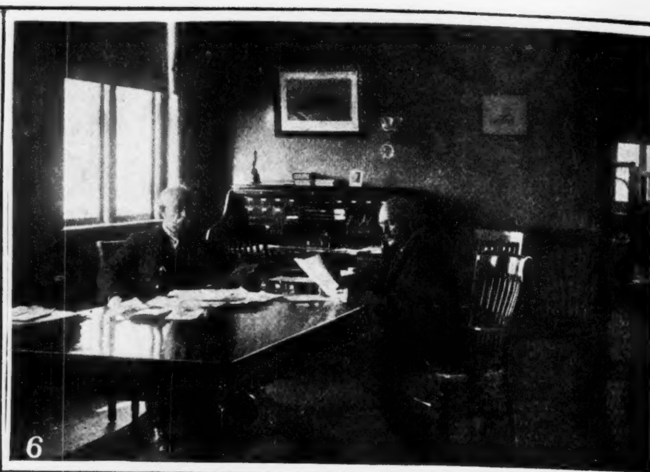
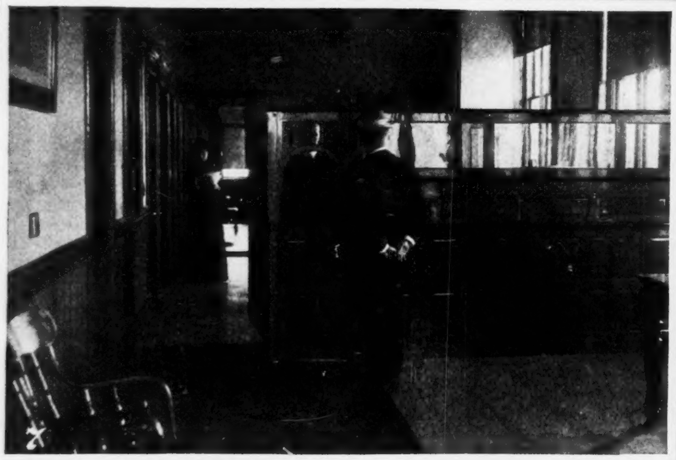
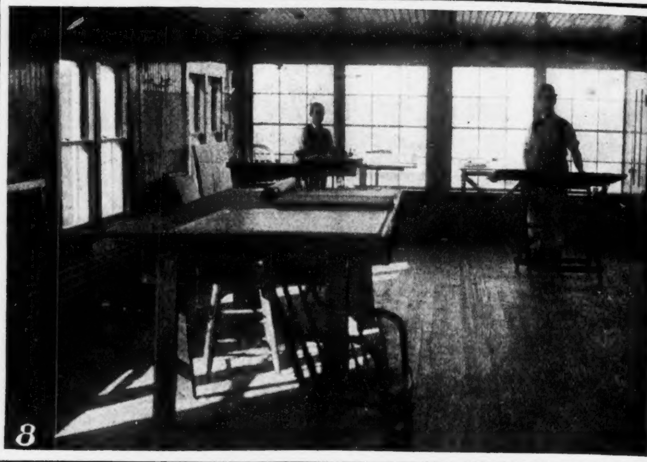


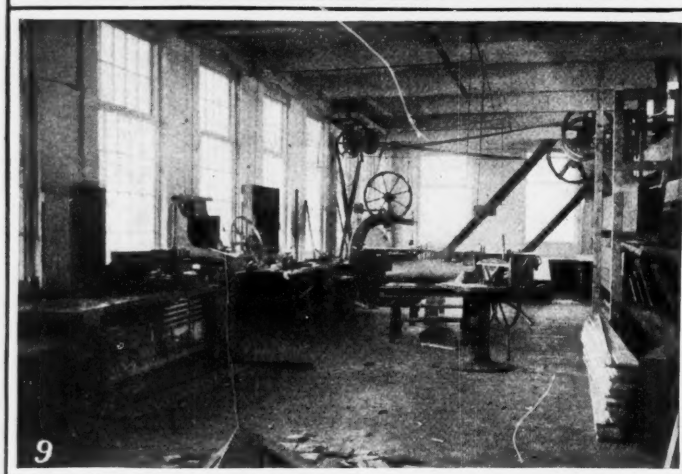
Diagram D.

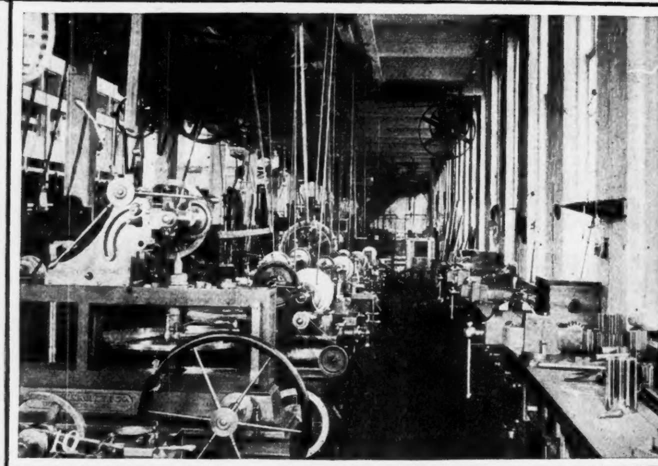


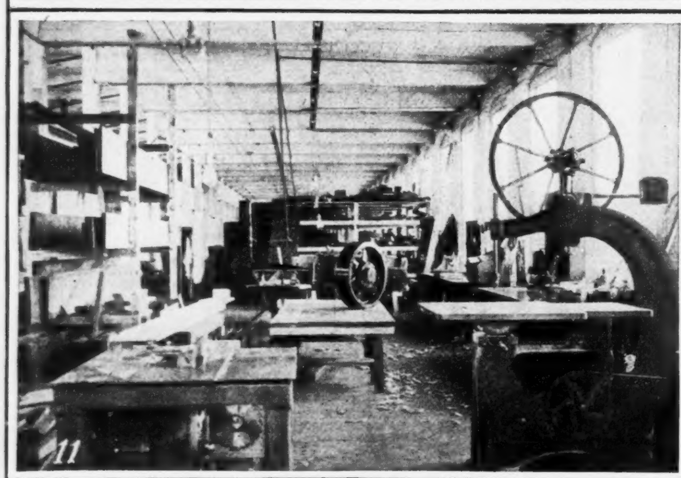












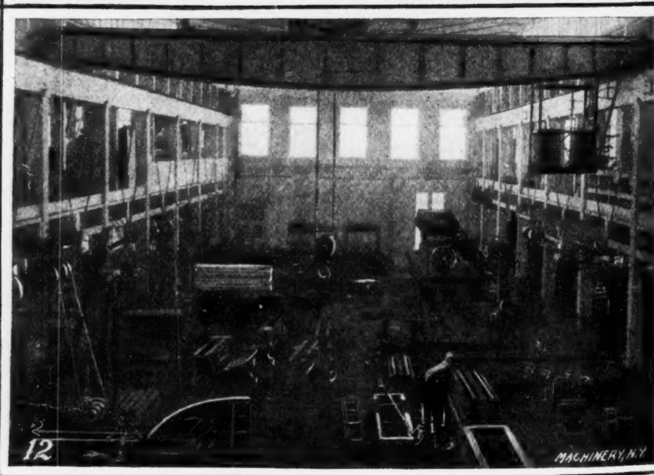


Fig. 5. New Shop of Woodward & Powell Planer Co.
Fig. 7. Anteroom of Main Office.
Fig. 9. Pattern Shop, Looking East.
Fig. 11. Pattern Shop, Looking West.

Fig. 6. Private Office, E. M. Woodward and A. M. Powell.
Fig. 8. Drafting Room.
Fig. 10. Under South Gallery, Looking East.
Fig. 12. Main Floor, from West Gallery.

MACHINE TOOLS, THEIR CONSTRUCTION AND MANIPULATION.—15.

FEED GEARS AND INDEX HEAD.

W. H. Van Dervoort.

A comparatively wide range of feeds to the table of the milling machine is considered quite important and especially so on the back-geared machines where the variation of the size and speed of cutters is considerable. This range of feed is usually accomplished by means of stepped pulleys, gearing, or a combination of the two. Thus a pair of four-step pulleys will give four changes of speed and if these pulleys are of different sizes, by transposing them on their spindles four more changes may be obtained. In Figs 134 and 135 is shown the mechanism used by the Cincinnati Milling Machine Company for obtaining the feed variation on the milling machines of their manufacture. A pair of gears, O and P, are secured to the spindle of the machine. Another pair, R and S, are mounted on the shaft Q, and by sliding over the shaft, R and O or S and P may be brought into mesh. Gear T transmits the motion of Q through the idlers U to the gear V, and cone pulley W. It is evident that with the gear in the position shown, three changes of feed can be obtained by shifting the feed belt. If S and P are thrown into mesh three more changes may be had. As gears V and T are of different diameters, changing places with them would give three additional feeds for each gear O and P on the spindle, or twelve feed changes in all. The idler U is mounted on an eccentric sleeve shown in Fig. 135, the

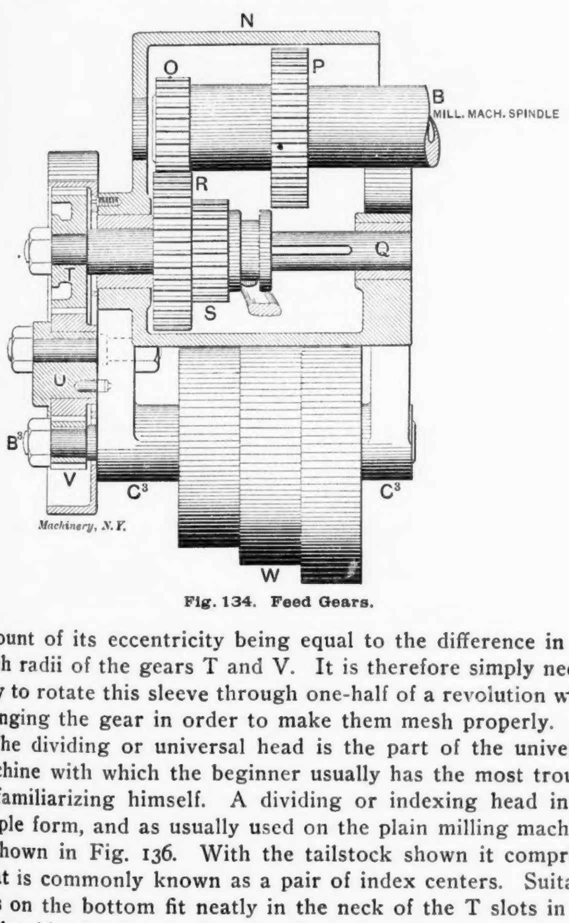


Fig. 134. Feed Gears.

amount of its eccentricity being equal to the difference in the pitch radii of the gears T and V. It is therefore simply necessary to rotate this sleeve through one-half of a revolution when changing the gear in order to make them mesh properly.

The dividing or universal head is the part of the universal machine with which the beginner usually has the most trouble in familiarizing himself. A dividing or indexing head in its simple form, and as usually used on the plain milling machine, is shown in Fig. 136. With the tailstock shown it comprises what is commonly known as a pair of index centers. Suitable lugs on the bottom fit neatly in the neck of the T slots in the work table, thus preserving the alignment of head and tail spindles. The head spindle is capable of rotation only. It carries a worm gear which is operated by the worm and crank shown. The ratio between worm and gear is, on all indexing heads, one to forty. In the one illustrated there are 80 teeth in the gear and a double thread on the worm. It is therefore necessary to make 40 turns of the crank and worm to make one turn of the gear and spindle. The crank moves over a carefully divided dial which is secured to the head. A small pin, adjustable radially in the crank, may be set to engage in the holes of any of the circles. As it is not desirable to have the index plates too large in diameter or the holes too small, several plates are necessary in order to get the range of divisions usually required. With the one shown three plates are furnished, making all divisions up to 50, all even divisions to 100, with many of the uneven divisions between 50 and 100, and many even and uneven divisions above 100. The sector serves to assist in counting the number of spaces between the holes and can be adjusted to include any desired number of spaces between its two radial arms. Since forty turns of the crank are required to make one turn of the spindle, the following rule

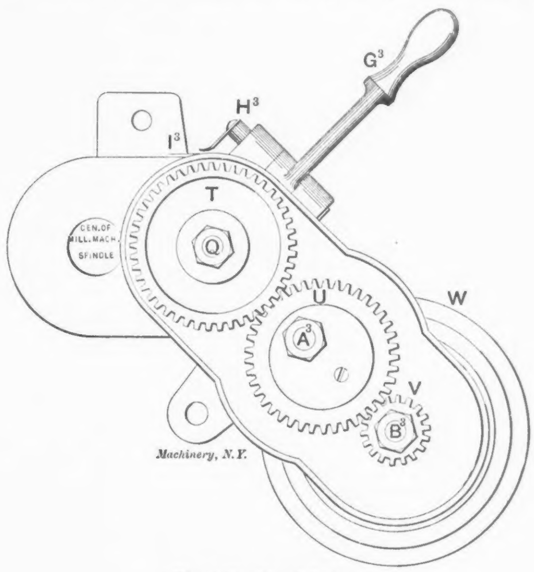


Fig. 135. Feed Gears.

may be given for determining the proper spacing. Take 40 as the numerator and the required number of divisions as the denominator, and reduce. Thus, it is required to cut 32 teeth in a gear, 40-32, or 1 8-32 of one revolution of the crank will make one division on the blank.

The sector should be set to include 8 spaces (9 holes) on the 32 circle, or 4 spaces on the 16 circle could be used. If 108 teeth were required, then 40-108 = 20-54 = 10-27, or 10 spaces on the 27 circle would give the required division. This ratio is not effected by multiplying or dividing both numerator and denominator by the same number. Therefore after reducing as low as possible, if that denominator does not correspond to the number of holes in any circle available, we can multiply or divide it by any number that would give us the proper number, also treating the numerator in the same manner. For example, 25 divisions require 40-25 = 1 3-5 turns. We can use any circle divisible by 5, as 20 or 4 times the denominator. Multiplying the numerator by 4 also gives 12 holes in the 20 circle.

As much of the miscellaneous dividing work done on an index head is for 2, 3, 4, 6, 8, 12 and 24 parts, a more rapid means of obtaining these divisions than by turning the worm

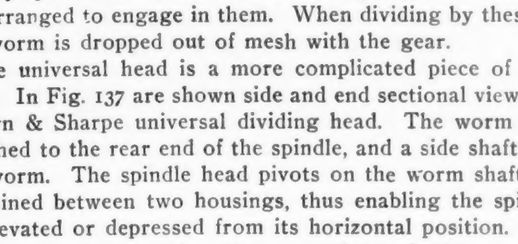


Fig. 136. Brown & Sharpe Index Centers.

is frequently applied. In the centers shown, there are 24 holes, equally spaced, in the face of the worm gear, with a substantial pin arranged to engage in them. When dividing by these holes the worm is dropped out of mesh with the gear.

The universal head is a more complicated piece of mechanism. In Fig. 137 are shown side and end sectional views of the Brown & Sharpe universal dividing head. The worm gear is attached to the rear end of the spindle, and a side shaft carries the worm. The spindle head pivots on the worm shaft and is contained between two housings, thus enabling the spindle to be elevated or depressed from its horizontal position. In the head shown the range is rather more than 90°. In some heads, however, the construction is such as to give a few more than 180°. The outer end of the worm shaft carries a sleeve T, free to rotate upon the shaft. Upon this sleeve is secured a bevel

gear and the dividing plate I. The crank J is secured to the worm shaft, and the sector S is held by a spring between the dividing plate and the crank with just enough friction to keep it in position when set. A post may be drawn out from the head and caused to engage in a suitable notch in the back of the plate, or, in cases where the holes are drilled through the plate, in one of the holes. This secures the dividing plate from rotation and divisions on the spindle are obtained in the same manner as described above. When it is required to rotate the spindle while the work is being operated upon by the cutter as is the case in the cutting of spirals, a geared combination between the worm spindle and the table-faced mechanism becomes necessary. In Fig. 138 is shown an end view of the dividing head, described in Fig. 137, secured on the end of the work table. The spindle S carries a bevel gear at its farther end, meshing with the bevel gear shown in Fig. 137. The gear marked "screw" is keyed to the feed screw and through the compound idlers transmits its motion to the gear and spindle S and through the bevels to the worm and worm gear. When the spindle is so geared the post W is disengaged from the plate and the worm shaft is driven from the dividing plate through the pin P and the crank J. It is obvious that when the feed screw is at rest, the plate I is held without the pin W and the required divisions are obtained by carrying the crank over the plate in the usual manner.

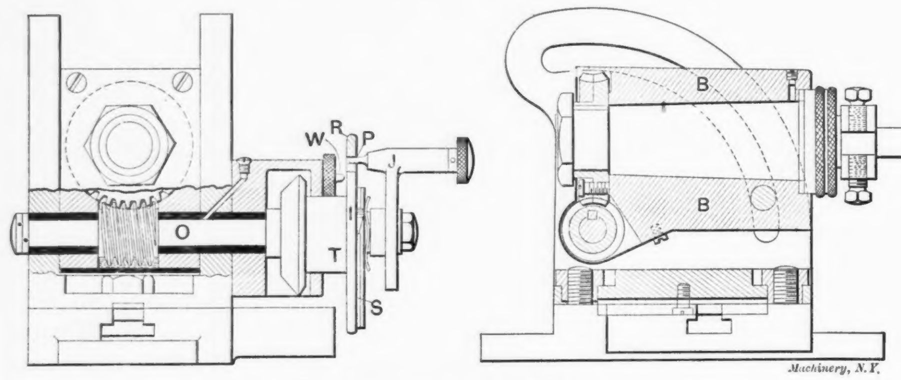


Fig. 137. Universal Head.

With all universal machines a table of change gears is provided for determining the proper gears to use for producing a large number of spirals of different pitch. Any desired pitch of spiral can be obtained by making special gears, and a good many pitches not given in the table may be produced by other combinations of the regular gears than those given. The proper gear for a required spiral pitch may be readily determined from the following considerations:

The table head or feed screws usually have four threads per inch. Assuming that number, if the gear of the screw had the same number of teeth as the one on the spindle S and was geared directly with it (that is, simple, not compound geared), then 40 turns of the screw would make 40 turns of the worm and one of the spindle; and as four turns of the screw are required per inch of the table motion, the pitch of the spiral would be 10 inches. If a spiral pitch of 6 inches was required, $6 \times 4 = 24$, the number of revolutions the screw must make while the work rotates through one revolution. Then the ratio $\frac{24}{40} = \frac{\text{teeth in driven gear}}{\text{teeth in driving gear}}$ Put gear with 40 teeth on the screw and gear 24 teeth on the spindle S. It is best when possible to use the simple gearing. If, however, the ratio is such that one of the gears would be extremely large or small, then the gearing should be compounded. For example: Required pitch of spiral, $32\frac{1}{2}$ inches; $32\frac{1}{2} \times 4 = 130$, or the revolutions of the screw per revolution of the work

$$\frac{130}{40} = \frac{\text{No. teeth in driven gear}}{\text{No. teeth in driving gear}}$$

As 130 would be a rather large gear and probably not furnished with the machine we could reduce the ratio to $\frac{65}{20}$, but this would also give numbers of teeth not usually furnished. It would then be necessary to compound. Resolve the ratio $\frac{130}{40}$ into factors $\frac{10}{5} \times \frac{13}{8}$; as these numbers are too low we can multiply both numerator and denominator by the same number, and we would have, for example, $\frac{10}{5} \times \frac{4}{4} = \frac{40}{20}$ and $\frac{13}{8} \times \frac{4}{4} = \frac{52}{32}$ and as $\frac{40}{20} \times \frac{52}{32} =$ the ratio $\frac{130}{40}$ we may use gears 40 and 52 as the driven gears. Either 20 or 32 can be placed on the screw and the other will be the inside gear on the stud Either the 40 or 52 can be put on the worm shaft S and the other will be the outside gear on the stud. If any of the gears called for were not found in the regular set, the numbers could be changed by treating both numerator and denominator without changing the ratio. Thus in the last problem, if the last set did not contain a gear tooth of 20 teeth, we could divide both numerator and denominator by a common factor and multiply the results by a number that would give numbers corresponding to available gears. Thus in the ratio $\frac{40}{20}$ divide both by $5 = \frac{8}{4}$ and multiply both by 6. This would give $\frac{48}{24}$, which alters the numbers but does not change the ratio. In this manner it is usually possible to so manipulate the ratios that the exact or a very close approximation to the required pitch can be obtained with the regular gears.

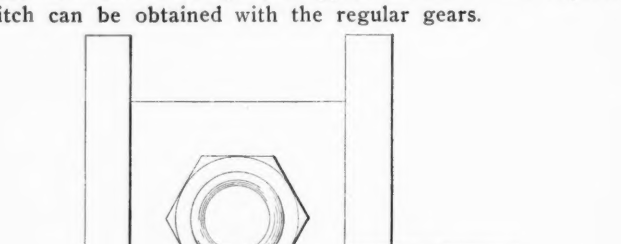


Fig. 138. Feed Gears for Right-hand Spiral.

The arrangement shown in Fig. 138 gives the proper rotation for cutting a right-hand spiral. If a left-hand spiral is required, another gear G must be put into the series. This gear is carried on an arm which is clamped to the post P, and the gear marked 40 drives 72 through G, thus changing the direction of rotation of the worm shaft and spindle.

In the cutting of all spirals the work table must be set at an angle with the cutter's axis, an amount equal to the spiral angle of the work. For equal pitch of spiral this angle varies with the diameter of the work; the larger the diameter the greater the angle.

It frequently becomes necessary to divide a circle into a num-

ber of parts which can not be obtained in the regular manner because a circle of the required number of holes is not on the index plate. If a circle for making one-half the required divisions is on the plate every other tooth can be cut, the work can then be rotated through one-half of one space and the balance of the teeth cut. Thus if 96 teeth are required and no circle available, set for cutting 48 teeth, which gives 10 spaces in the 12 circle or 15 spaces in the 18 circle. After cutting once around, move the pin through 7½ spaces, and being careful that it is not moved, cut partly through on the tooth; stop the machine without throwing out the feed and carefully adjust the driver to make up for the ½ space, which brings the pin into another hole, and proceed with the cutting as for the first half. With care in the adjustment, the error in making the ½ setting will be slight.

A method of compound indexing can be used to excellent advantage for obtaining with the regular plates many divisions that may not be had in the regular manner. The application of this method requires plates with the holes drilled through, and the back pin W radially adjustable. The method consists in indexing forward on the front side of the plate in the regular manner and adding to or subtracting from this movement another movement indexed from the back side of the plate. From tables calculated by W. Gribbons, to divide into 91 parts, index forward, on the front of the plate, six spaces on the 39 circle; then index forward on the back of the plate, 14 spaces on the 49 circle. This gives $\frac{6}{39}+\frac{14}{49}=\frac{2}{13}+\frac{14}{49}=\frac{98+182}{637}=\frac{280}{637}=\frac{40}{91}$ or the equivalent of 40 holes in a 91 circle. If 99 spaces are required, index forward 15 spaces on the 27 circle and backward 5 spaces on the 33 circle. This gives $\frac{15}{27}-\frac{5}{33}=\frac{5}{9}-\frac{5}{33}=\frac{165-45}{297}=\frac{120}{297}=\frac{40}{99}$, or the equivalent of 40 holes in a 99 circle.

For correct indexing there should be no slack or back lash in any of the parts. It is advisable, however, not to carry the crank and its pin past the hole, but to bring it up to the hole without the necessity of carrying it back, which would serve to let any slack affect the accuracy of the division. It is advisable in order to prevent confusion for the operator always to rotate the crank in the same direction, unless there is some special reason for doing otherwise.

The radial arms of the sector are held in position with reference to each other, by friction. In rotating them over the face of the plate, always take hold of the arm that strikes the pin, as there will then be no danger of changing their relative position through striking the pin with considerable force.

* * *

The E. P. Allis Company, Milwaukee, Wis., have recently made a casting in their foundry weighing 110,000 pounds, for the bed plate of a blowing engine designed for the Carnegie Steel Company, Pittsburg, Pa. One hundred and twenty-six thousand pounds of metal were poured in order to produce the casting, and it has been claimed that this is the largest single casting ever poured. This is not the case, however. One of the heads for the fluid compression press at the Bethlehem Steel Company's plant, South Bethlehem, Pa., weighed when cast 270,000 pounds, and steel castings for armor plate have been made as heavy as this. These castings are thus 2½ times as heavy as the Allis casting, which, however, is an unusual one.

* * *

The first trial of the third-rail system of electric propulsion on the New York elevated roads took place recently with satisfactory results. The trial train consisted of six cars, the two end cars being each equipped with four motors. The two motor cars were arranged so that the cabs were respectively at the front and rear ends of the train. The trip from 92d street to 54th street, a distance of thirty-eight blocks, was run in four minutes, at a speed of thirty miles an hour. It was found, as expected, that the motors accelerated the speed of the train more rapidly than the locomotive and the substitution of the air brake for the vacuum brake, so long employed on the elevated road, will also tend to reduce the time required for stops.

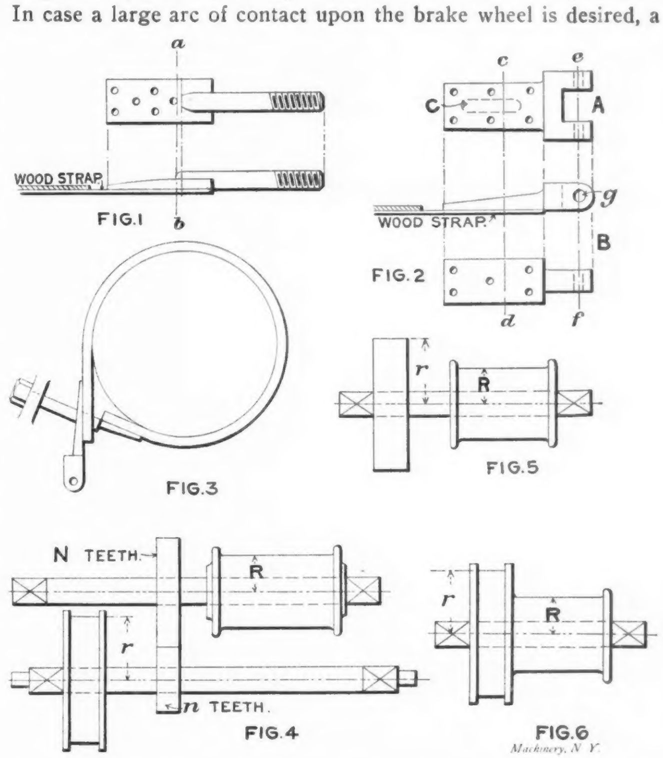
BAND BRAKES.

A DIAGRAM, WITH DIRECTIONS, FOR OBTAINING THEIR PROPORTIONS.

C. F. Blake

Band brakes, as used in hoisting machinery, consist of a band wrapped partly around the circumference of a wheel, one end fixed in an immovable portion of the machine, and the other end attached to a system of levers, by which the slack is taken up and the band tightened upon the wheel.

The band is made of wrought-iron or steel and is usually lined with wood, preferably basswood, next to the wheel. Basswood is used because it combines uniformity of bending—and thus gripping power—with great durability. The wood is riveted to the iron strap, with its grain parallel to the length of the strap. It is also customary with many manufacturers to use short blocks of wood riveted to the iron band in place of a continuous strip. The iron band is riveted onto two forged ends, one of which, shown in Fig. 1, is threaded to allow for proper adjustment, and for taking up the wear of the strap. The other strap end, shown in Fig. 2, is arranged to take a lever, and may be forked for a single lever, as at A, or may be made for a forked lever, as at B. In case a large arc of contact upon the brake wheel is desired, a



slot C, Fig. 2, may be cut in the strap end, large enough to allow the threaded portion of the other strap end, Fig. 1, to pass through. If now the strap end in Fig. 2 is placed very close to the wheel, and the threaded part of strap end in Fig. 1 is made long enough to pass through and fasten upon the outer side of the strap, a very large arc of contact will be obtained. This arrangement is shown in Fig. 3. The slot in the strap end must be long enough to allow for movement to take up all the slack in the band. Ordinarily the band is adjusted so closely that ¾" is all the end movement required to set the brake. The slot, however, should be cut at least four or five times the diameter of the threaded part of the strap end in Fig. 1, to allow for taking up the wear, and for inaccuracies in the shop.

Adopting the notation of the accompanying chart, the holding power equals the difference between the tight and loose ends of the band, or

$$P = T_2 - T_1$$

In calculating the pull T_1 upon the loose end, it is usual to assume the force applied by an average man upon a hand lever as 50 to 60 pounds, while upon a foot lever it cannot be more than the weight of the operator. The cross section of the strap, the section a-b of the strap end in Fig. 1, the section of the threaded portion at the bottom of the thread, and the number and size of rivets in single shear in the strap end should be able to hold the pull T_2 upon the tight end of the strap. The section c-d and e-f in Fig. 2, should be strong enough to hold the pull T_1 upon the

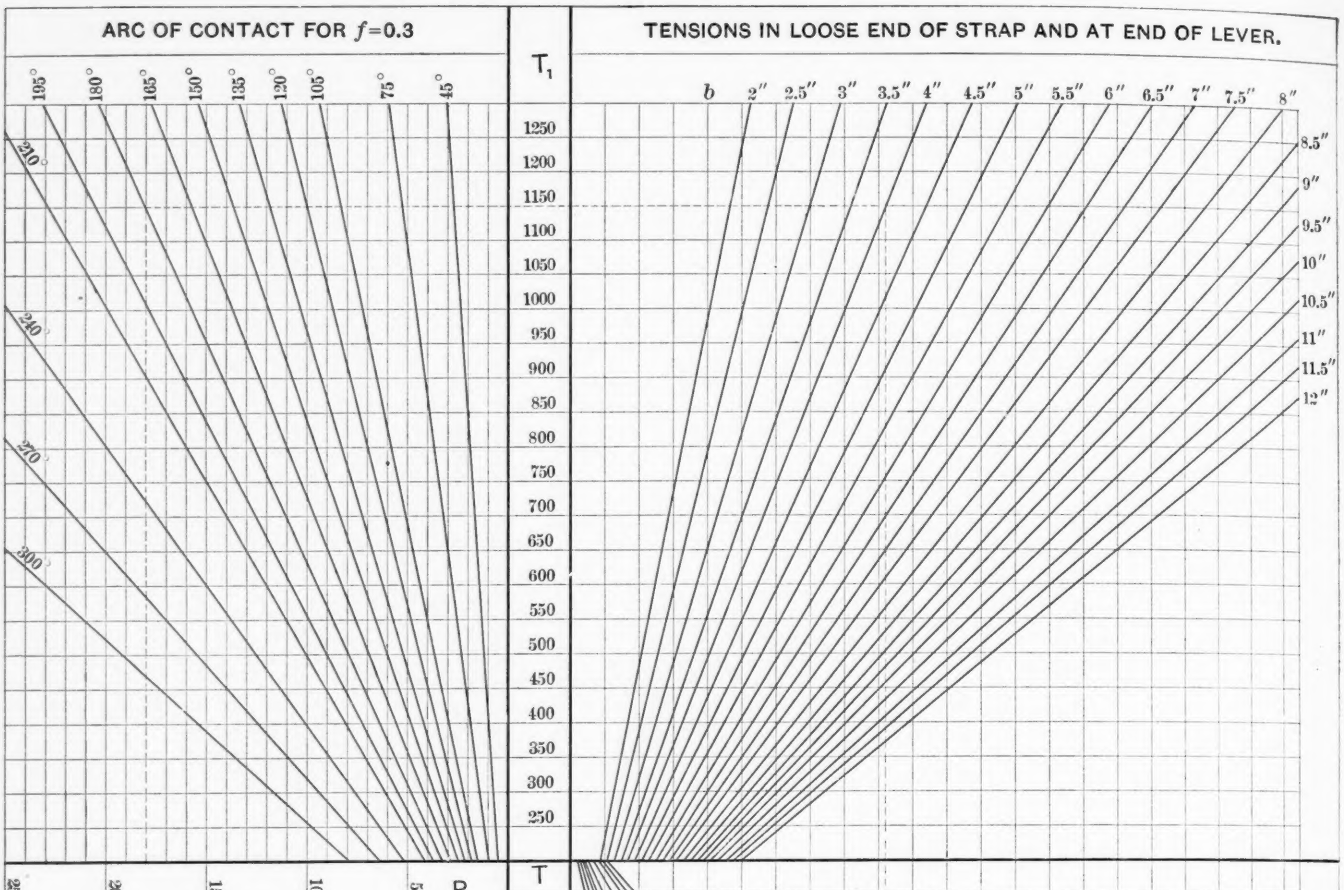


DIAGRAM FOR DESIGNING BAND BRAKES.

loose end of the strap, and the diameter of the pin g should be ample to hold the pull T_1 in double shear. Referring now to the figure in the chart, and using the notation of the chart we have

$$\frac{T\,a}{b} = T_1$$

letting

$$\frac{T_2}{T_1} = k \qquad (1)$$

and substituting for T_1 its value above we have

$$\frac{T_2}{\frac{T\,a}{b}} = k$$

$$T_2 = \frac{k\,T\,a}{b} \qquad (2)$$

or substituting these values of T_1 and T_2 in the equation

$$P = T_2 - T_1$$

We have

$$\frac{k\,T\,a}{b} - \frac{T\,a}{b} = P$$

or

$$P = \frac{T\,a\,(k-1)}{b} \qquad (3)$$

Values of k for use in this formula will be found tabulated for different lengths of the arc of contact, and different coefficients

of friction, in one corner of the chart. Assuming a problem to illustrate the use of the chart, let us suppose a force P=1,800 pounds is to be held by the brake, having an arc of contact of 180°; coefficient of friction of .3; length of arm b = 4", and force applied by operator 128 pounds; what is the required length of arm a?

Starting at 1,800 pounds under f = .3, follow up to the 180° line, thence to the right of line representing b = 4", thence down, meeting horizontal line from 128 pounds on line representing a = 36". This will be the length required. Looking in the column headed T_1 we read 1,150 pounds, which is the pull upon the loose end of the strap. This multiplied by k = 2.56, obtained from the table opposite 180° and under f = .3, will give T_2 the pull upon the tight end of the strap as 2,944 pounds. In case of a larger value of P than is shown in the chart, proceed as follows: Remembering that $T_1 = \frac{T\,a}{b}$ we have from equation 3

$$P = T_1 (k - 1)$$

$$T_1 = \frac{P}{k - 1} \qquad (4)$$

Or thus: If P = 10,000 pounds under the above conditions, find as before k = 2.56. Then substituting in equation 4, we have

$$T_1 = \frac{10{,}000}{2.56 - 1} = 6{,}410 \text{ pounds.}$$

and as $T_2 = kT_1$, $T_2 = 6{,}410 \times 2.56 = 16{,}409$ pounds.

Suppose now the brake wheel to be upon an intermediate shaft geared to the drum shaft (a common practice) as in Fig. 4.

Let R = the radius of the drum,
N = the number of teeth in gear on drum shaft,
n = the number of teeth in gear on intermediate shaft,
r = radius of brake wheel,
F = force in pounds in rope or chain wound. upon the drum,

then $\frac{F\,R\,n}{N\,r}$ = the pull P in the chart.

If the brake wheel is to be placed upon the drum shaft, as in Fig. 5, or, as is sometimes the case, is to be cast upon the drum, as in Fig. 6, the pull P in the chart is

$$P = \frac{F.R}{r}$$

The brake wheel may be made by the ordinary rules for pulleys, carrying a tangential force = P. The face of the brake wheel is sometimes grooved to fit the band as in Figs. 4 and 6, or it may be left flat as in Fig. 5.

* * *

It is a fad with certain journals of a popular nature to occasionally publish articles of an alleged engineering nature. Some of these efforts are truly wonderful in conception, but scarcely practical except on paper. One of the latest efforts in this line which appeared in a recent issue of a woman's journal states among other startling innovations, that before many years we shall cross the Atlantic on fast electric ships at a speed of more than a mile a minute, only two days being required for the trip from New York to Liverpool. In his description of these wonderful greyhounds the writer says: "They will be supported on runners somewhat like those of the sleigh." What this means we know not, unless it is expected by the writer that liquid air is to be used for freezing a pathway across the heaving deep for these unique "electric sleighs."

Directions for using Chart on Opposite Page.

Using that part of the chart in the upper left-hand corner, for a coefficient of friction of .3, start with the known load, P, and follow up to the line representing the arc of contact; thence to the right to the line representing the length of arm b; thence down to the line representing the length of arm a; thence to the left and read the pull in pounds required to hold the load P.

Conversely.—Starting with known pull, T, and assumed lever arms a and b, follow back through the chart to part for coefficient of friction and line representing the arc of contact, and below read load, P, which will be held. Knowing load P and arc of contact, and assuming arm b and pull T, arm a will be found at the intersection of the vertical line from arm b and horizontal line from pull T. For T_2, read T_1 in chart and multiply by k as found in table below.

For coefficients of friction other than 0.3 the quantities can be calculated by the formulas given below.

FORMULÆ.

$$k = \frac{T_2}{T_1} \qquad P = \frac{T\,a\,(k-1)}{b} \qquad T = \frac{P\,b}{a\,(k-1)}$$

$$T_1 = \frac{T\,a}{b} \qquad T_2 = \frac{k\,T\,a}{b} \qquad T_2 = k\,T_1$$

P = Load in pounds on circumference of brake wheel.
T = Pull exerted at lever handle.
T_1 = Tension in loose end of strap.
T_2 = Tension in fixed end of strap.
a = Long lever arm.
b = Short lever arm.

f FOR DIFFERENT MATERIALS ON CAST IRON.

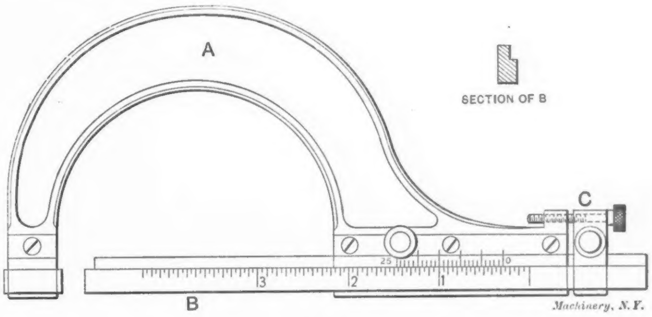
Material.	Wet.	Dry.	Oily.	Greasy.		Authority.
Leather	.36	56	.15	.23	....	Rankine.
"	....	....	....	....	.28	Thurston
"	....	....	....	...	.18	Hermann.
Oak	.20	....	....	....	..	Rankine.

Arc of Contact	$k = \frac{T_2}{T_1}$ for f			
	f = 0.2	f = 0.3	f = 0.4	f = 0.5
20	1.07	1.11	1.15	1.19
30	1.11	1.17	1.23	1.30
40	1.15	1.23	1.32	1.41
45	1.17	1.26	1.36	1.48
60	1.23	1.36	1.52	1.69
75	1.29	1.48	1.68	1.92
80	1.32	1.52	1.74	2.01
90	1.36	1.60	1.87	2.19
100	1.41	1.68	2.01	2.39
105	1.44	1.73	2.08	2.50
120	1.52	1.87	2.31	2.85
135	1.60	2.02	2.56	3.24
140	1.63	2.08	2.65	3.39
150	1.68	2.19	2.85	3.70
160	1.74	2.31	3.05	4.04
165	1.77	2.37	3.16	4.22
180	1.87	2.56	3.51	4.80
195	1.97	2.77	3.90	5.48
200	2.01	2.85	4.04	5.72
210	2.08	3.00	4.33	6.25
220	2.15	3.16	4.64	6.82
240	2.31	3.51	5.34	8.12
270	2.56	4.11	6.59	10.55
300	2.84	4.80	8.11	13.70

A VERNIER CALIPER.

F. W. CLOUGH.

The cut represents a form of caliper frame similar to that used by the makers of the screw micrometer caliper. This is a vernier caliper, consisting of a caliper frame A, having a slide way and gib provided in which caliper bar B can be moved in or out at will, when the binding screw is released. The form of caliper bar is shown in section and is graduated so that by a suitable vernier, readings of 1-1,000 of an inch can be obtained. The vernier graduation is cut on the gib plate for the caliper bar and a follower head, C, is provided by which exact size readings may be obtained with ease. The



cut represents a 3-inch caliper which can be set to size quickly in or out, minus the slow process of a screw movement. Unlike most screw micrometers, it can be used to measure any part of the 3 inches, while most of screw micrometers measure only 1 inch of their capacity. The general features of this tool is that it is minus small get-out-of-order "clap traps," the caliper bar is one simple straight piece having graduation cut on the front face and the reading of caliper bar and vernier is on the same plane, which is desirable. The vernier represented is twice the length of those usually made for 40-to-the-inch space.

This tool has been tested by a 2-inch model and found to work satisfactorily.

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UNITED KINGDOM.—Sampson Low, Marston & Co., St. Dunstan's House, Fleet Street, London, E.C.

JANUARY, 1901.

CIRCULATION STATEMENT.

The regular edition of MACHINERY for January is 27,500 copies.

MACHINERY has the largest paid-in-advance circulation of any mechanical paper in the world. No subscriber is entered on our mailing list until his subscription is paid for, and all subscriptions are stopped at expiration. Except on special quarterly numbers, no papers are sent free other than to advertisers, exchanges and circulation agents. AMERICAN MACHINERY is the title of the foreign edition, printed on thin paper and comprising all the reading and advertising matter in the domestic edition. The regular editions of MACHINERY for the last twelve months are given below:

1900.		1900.		1900.	
February	20,500	July	22,000	December	27,500
March	25,000	August	21,500	1901.	
April	21,500	September	21,750	January	27,500
May	21,500	October	24,000		
June	27,500	November	25,000		

A HINT UPON HOME STUDY.

Many young mechanics feel that they ought to engage in some form of study in connection with their regular work. On the following pages will be found a few hints for those who can arrange to take a technical course; but for every one who can do this there are many who either cannot or believe it to be impracticable to do so. Nevertheless, this is no reason why a mechanic should not engage in some form of study, at his own home if nowhere else.

The main difficulty in home study is to know how to begin. It is not easy to get into the spirit of it any more than it is easy to enter into any other kind of work that one is not accustomed to. It seems like a great undertaking to commence a course of study, and the general result is that the matter is dropped altogether, and no effort is made in that direction. If it can be once appreciated, however, that study can begin in connection with one's every-day work and the questions that arise concerning it, the way becomes easier. By devoting attention to such subjects, and then investigating from time to time other subjects that suggest themselves, it is surprising how much headway can be made.

The best place for a machinist to begin a course of study is in the machine shop itself, and the first step in such a course ought to be to learn to think and reason about the work that is being done on every hand. One of the greatest mistakes that an apprentice can make is to suppose that a particular shop or any particular men can teach him the machinist's trade. They can guide him, but the trade must be learned, not taught, and the apprentice must set himself about learning it himself through his own experience, observation and investigation. It is also a mistake to suppose that one must undertake an elaborate course of study with many books, and perhaps at large expense, before he can become a student. Education is not necessarily "book learning." It is obtaining a broad knowledge of things, whether of mathematics or the tools of a shop; and the broader the knowledge and the more things to which it applies the better the education.

Let the young mechanic begin his study by observation, inquiry and reading about whatever pertains to shop work. Let him study how this or that job is to be done; observe how the screw machine is set up for a particular piece; become familiar with speeds and feeds and the small tools of the tool room, concerning which there is much to be learned; and in case he is at work on a milling machine, make sure that he learns all he can about it, including indexing and cutting spirals. Innumerable subjects present themselves that require no books and can be learned only through shop associations. They are the things to learn first, and it is better to do a little thinking about them, both during and after shop hours, than to pass all the time in idle thought.

In the evening a study of catalogues will be found beneficial, and after these a few simple shop calculations can be taken up, like lathe change gears, the speeds and diameters of pulleys, and tap-drill sizes. Following this, one would naturally wish to investigate such common shop subjects as gear teeth and working drawings. Evening and correspondence schools are of great assistance to one who wishes to study, but we think we have shown that they are not absolutely necessary, and, in fact, that one can begin to be a student even without books.

* * *

A question of current interest to those who find themselves imbued with the automobile craze is the action of the Treasury Department upon the question of whether gasolene may lawfully be carried in the tanks of automobiles upon ferry boats. The statutes now provide that no benzine or coal oil or like explosive burning fluid or like dangerous articles shall be carried as freight or used as stores. The Automobile Club of America is endeavoring to obtain a new interpretation of the law, applicable to automobiles, on the technical ground that an automobile is not "freight" in the sense of the statute, and a test case is to be made. This is very evidently a case where the law ought to be interpreted in favor of the government and of safety, if it is found that there is uncertainty as to its original intent and purpose. Any one who has been a passenger on a New York ferry boat during the rush hours of night or morning will fully appreciate what a horrible disaster a fire would be on one of these boats during these hours. The decks and upper portions of the boats are mere kindling wood, and the central space between the cabins, for carriages and trucks, is open from end to end, permitting a current of air to rush through, which would fan into furious flame any fire that might start there. A boat of this construction, often loaded with passengers to twice its safe capacity, is the fuel that would be furnished a fire that started during the boat's passage. To add to the horror, it is probable that the commanding officer would not dare beach the boat, because of the certain danger of communicating the flames to the adjoining shipping and docks.

* * *

A recent change in the schedules of mail trains rendered it necessary for the Chicago, Burlington and Quincy Railway Company to obtain some new mail cars on very short notice. In the forenoon of November 5, the Pullman Company was requested to furnish at the earliest possible moment three 60-foot mail cars of the latest design, fully equipped and ready for service. The order was completed in ten working days. The cars were built complete from the rough stock in this time, including painting, varnishing and lettering, and the interior fittings, including letter cases.

TECHNICAL EDUCATION.

WHAT THE TECHNICAL SCHOOLS OFFER TO THOSE CONTEMPLATING A COURSE OF STUDY, WITH SPECIAL REFERENCE TO MACHINISTS AND DRAFTSMEN.

It is very evident that there is a growing desire on the part of machinists, draftsmen and others, who have had considerable practical experience, to obtain a technical education. These men frequently lack adequate preparatory education and it is often the case that they do not have the means to complete a technical course without depriving themselves of many of the comforts and possibly some of the necessities of life. At the same time, there is an increasing number every year who manage by one means or another to secure a more advanced education and the positions that these men are filling give evidence that the hard work and the time necessary for completing such a course of study have, on the whole, been profitably spent.

Twenty-five years ago there were probably not half a dozen schools in the country giving courses in mechanical engineering. Ten years ago only a few of the larger and better known institutions had such courses. At the present time most of the colleges of the country offer instruction in engineering subjects, in one form or another. There are now at least fifty colleges giving successful courses in mechanical and electrical engineering.

The rapid increase in this branch of instruction can be explained only on the ground that there has been an increasing demand for such instruction. This demand comes not only from the wealthy and well-to-do, but from those in ordinary or limited circumstances as well. It has been our experience that quite as many students taking these engineering courses come from families of limited means as from families that are well able to pay the expenses of the course.

In view of this widespread interest in technical education, and in response to inquiries that we have received from time to time, we have gathered together in this number information from several colleges and technical schools that we think will be appreciated by all of our readers who are giving the subject of education any thought. In order to secure the desired information we sent the following letter to a selected list of schools and colleges:

LETTER OF INQUIRY.

Dear Sir—Our publication circulates among men connected with machine shops, many of whom would like to take a technical course, but who in some instances feel that they lack the means and preparation. Will you kindly send us a brief letter stating what preparation such a prospective student would need for either a special or regular course in mechanical or electrical engineering at your institution, and what financial inducements or help you could offer him? We would like to have included information as to lowest possible expenses and whether a knowledge of shop work or drawing would, in a measure, offset other entrance deficiencies. We trust that some may be helped by this means in obtaining an education. Yours truly,

LESTER G. FRENCH, Editor.

Replies have not yet been received from all the institutions written to, but we have heard from a sufficient number in widely separated parts of the country to indicate what is being done for the class of students to whom we refer. Where the letters were of particular interest or gave information that would be helpful we have published them either in full or in part; in other cases we simply condensed the information into the briefest possible space. We think it safe to say that no young man who is a good machinist or draftsman, who has his health, and who has no others to support, need go without a technical education if he really desires one. Some of the schools have courses that may be followed at an annual expense as low as $225 a year. Others offer to loan the amount of the tuition until after graduation, while in most cases there are scholarships affording free tuition to a limited number of worthy and capable students. In all cases there is a long summer vacation in which to accumulate a little money. If a four years' course is not possible under these conditions, there are several excellent opportunities for obtaining shorter courses, in which some of the more practical studies are incorporated No one can doubt the efficacy of even one of these courses, since it enables one to learn more in a shorter space of time than he could learn in commercial work in a much longer time. There can be no doubt that the combination of a practical knowledge of machine work or drafting and a technical education is a winning one and we believe that each succeeding year there will be more draftsmen and machinists who will acquire a technical training. The letters and information that we have received are given below:

CORNELL UNIVERSITY, ITHACA, N. Y.

The Editor of MACHINERY has asked for a statement of the requirements for entrance into the technical courses at Cornell and especially into the courses in mechanical engineering and the mechanic arts. This it is a great pleasure to supply, especially as the paper circulates largely among just those men who are most interested in the promotion of scientific and technical training. To enter upon a course of study in a college school of engineering, a good preparation in mathematics is demanded, including, as the first requirement, for the best schools, the highest of the high school branches; for the engineer's work is facilitated, in all departments, by the use of the higher mathematics and especially of the science of applied mechanics, which involves those studies. To enter upon the full course as a candidate for a degree also involves good preparation in other branches of high school study and especially in the modern languages; for the literature of engineering is very largely to be found in the French and German languages and the man who intends to stand among the leaders of his profession after a time, must know what is being done in all parts of the world, and must be able to find, and clearly to understand, in the publications of Europe as well as of America, accounts of all the latest and most useful advances in those sciences which find application in his work. All this means, for the average man, the consecration of much valuable time, much hard work and considerable money to the task of simply preparing for college; but many young men do it, earning their living and paying their way to the highest and best of technical schools, and through them. It means time, patience, industry and frugality, but it is a common thing, and such men are surest to attain the highest positions in the profession.

I know one young man who worked in railroad machine shops and in college, alternate years, and finally, after eight years, completed his course and became, later, a well-known man and a successful man from a business point of view. I know another who lived in college on sixty cents a week, to the end of his course. Still another "found himself" in college and lived on $1.25 a week and is now manager of one of the most important manufacturing establishments in the country making electrical apparatus and products. Still another, at the age of 32, accumulated a little money, placed his wife and baby in a country village where they could live inexpensively, but healthfully, lived four years alone at college, exiled from his family, and later made a successful transfer from his old and unpromising vocation into a new and, as it proved, profitable business.

But not all men can give either time or money to preparation, to the extent demanded for such complete college work, and the schools are usually prepared to do what is practicable to make the way easier to those unable to take full advantage of all the educational opportunities offered the more fortunate young men of the community. Thus: Cornell University offers six hundred "state scholarships," involving no payment of tuition fees, to those who succeed in a public competition held in all the election districts of the State of New York at stated periods. A considerable number of other scholarships for candidates for entrance into the undergraduate work, and fellowships for advanced students, often paying a fairly good income, are also offered as the prizes of successful competition at the University, and, in one case, in architecture, a $2,000 prize is thus awarded.

For young men, not less than twenty years old, the privilege is allowed of entering, without examination, any courses in which he is competent to take up the work, and many young men from the shops thus secure a preparation for later and

better work otherwise impossible to them, and now and then one begins in this manner and, later, finds a way to perfect himself in the subjects demanded for entrance upon candidacy for a degree, and ultimately secures his certificate of complete success and becomes one of the class which he previously so greatly envied and an alumnus of the college. Thus, although the student in a course of college work in mechanical engineering of whatever kind, general, electrical, marine or railway engineering, spends hundreds of dollars each year for a number of years to secure his diploma in engineering, much may be accomplished by a man of pluck and ambition, with a spirit of self-sacrifice, on a comparatively small sum. When such a course proves practicable it will handsomely recompense the hero who conquers such difficulties.

In the larger cities, fortunately for this class of men, there are now to be found institutions which facilitate his work in self-instruction and self-education enormously, and the Cooper Institute in New York, the pioneer in this grand work, is a good example. Others are the Pratt Institute, Brooklyn; the Auchinschloss schools, New York; the Drexel Institute, Philadelphia; the Lewis and the Armour Institutes, Chicago, and others, including the best correspondence schools, in which excellent courses of instruction are given. Often evening as well as day classes are organized in mathematics and the sciences, and in the shops and drawing rooms, together with the more elementary, sometimes even the advanced, applied sciences of engineering, and all at little cost to the pupil. These schools, also, are often excellent preparatory schools for the technical schools and colleges of most advanced grade, such as the Massachusetts Institute of Technology, the Rensselaer and Stevens Institutes, Sibley College, and the engineering schools of the colleges and the universities generally, in which technical courses of high character are offered and which have freed themselves from the trammels of the older and traditional spirit of monastic learning.

Every institution of learning and all technical schools have their circulars and catalogues, in which are given their entrance requirements, courses and fees, and a statement of expenses, and these can always be had on application and for comparison. Where one can afford the time and the expense, a visit to two or three, after a study of their circulars, will promptly settle the question which is best for the purposes of the individual concerned at the moment.

In some individual and exceptional cases it is possible to find a way of earning something while in college. I have known a man, during his vacations, holidays and spare hours, to earn more than his expenses by doing fine work in fitting up houses for electric light distribution, wiring for electric bells, and other work. One man boasted that he left college considerably richer than when he entered and another, by securing and subletting a contract, in a remote town, for an electric lighting plant, made a surplus of some thousands of dollars; but these are not cases to be taken as giving much encouragement to the average student. He must usually make a business of study and study only.

R. H. Thurston.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON.

Editor Machinery:

The terms upon which we can admit a student depend to a considerable extent on his age. Any applicant needs to be well prepared in algebra and plane and solid geometry as a minimum, whether for a regular or a special course in engineering. Any applicant who has this preparation may enter as a special student in case his age or other good reasons have prevented him from completing preparation in other directions. If an applicant's mathematical preparation is defective, the question of admission will often turn on age; that is, we are willing to test an applicant who is twenty-one or over by giving him a chance to try our work even if his ability to pass entrance examinations is deficient. The type of young man you have in mind is often, I suppose, a grammar school graduate with some mathematical aptitude, but very little time for study. He should get all the algebra and geometry he can by himself and by attending evening school. He should not come to the Institute until he is well prepared and until he can see his way clear to meet the expenses of the first year, and not at all, of course, unless he has the health and strength necessary for hard work.

Our scholarship funds are in general restricted to regular students who have completed a year or more of good work and are known to be in need. Occasionally, however, we assist students in the second term of their first year if their first term records are good, and we are generally glad to treat any man as regular who has a reasonable plan for becoming so. In this connection I should say that such an applicant as I have suggested might expect provisional admission to our work in English and history with a chance of excuse from entrance conditions on the basis of good term work. In French and German he would have to take an additional year's work here if he had passed no entrance examinations.

Returning to the matter of expense, the possible latitude in a city of this size is, of course, very great. Many of our scholarship applicants get on for $5 per week or less for room and board, although such economy involves some degree of hard ship. I am always glad to correspond directly with any young man who has the wish to come here, but lacks means. Not seldom, however, I feel obliged to suggest attendance at some other less expensive college as an alternative with the possibility of entering our course later at a more advanced point.

F. W. Tyler, Secretary.

LELAND STANFORD JUNIOR UNIVERSITY, STANFORD UNIVERSITY, CAL.

A person who has had a good common school education, including plane geometry and elementary algebra, but who cannot fulfill the requirements for entrance as a regular student, can enter the University as a special student, provided he is at least twenty-one years of age, and has had practical experience of a nature satisfactory to the authorities.

For instance, a man 21 years of age, who had served his apprenticeship as a machinist, would probably have had a sufficiently varied experience to be acceptable as a special student in mechanical engineering; or, one who had spent some time building, erecting or running electrical machinery would probably be acceptable in electrical engineering. No general law can be stated, as each individual case is considered separately.

A special student cannot take a degree unless he first meets the requirements for regular entrance. These requirements can be made up at any time during his course. Practice in drafting and shopwork are taken as equivalents of part of the subjects required for entrance.

We have had a number of students come to us as specials after more or less practical experience, and they have included some of our very best men. At least two of our graduates of this kind are now teachers in the technical departments of universities of the highest standing. More would occur to me if I were to look over the lists.

At present we have, among other specials in mechanical engineering, one who has been a stationary steam engineer for twelve years; another who has had fourteen years of experience as a machinist; a third who has had three years of mechanical work in mines, and so on.

A man should be convinced that the study of mathematical subjects possesses no terror for him before he enters into a course in higher technical education. Not that mathematics proper constitute the main part of his course, but for this reason—unless he masters his mathematics he will never reach the purely technical subjects.

Regarding the financial side the situation is briefly as follows:

There are no scholarships which give a student financial assistance but a great many students support themselves throughout their course.

A man with a trade can earn enough in the shops of San Francisco during the summer to carry him well through the year. A number of our men have done this. The expenses of a student, exclusive of clothing and railway fares, need not exceed $225 per year.

G. H. Marx.

TUFTS COLLEGE, TUFTS COLLEGE, MASS.

Editor Machinery:

You ask for information concerning the opportunities offered by Tufts College to prospective students who have had shop experience, but are deficient in the preparation required for a technical course.

We have recognized this need and established a department designed to meet the wants of young men whose preparation

for engineering studies may be deficient, but whose practice and experience in the applied part of engineering may qualify them to pursue some of the regular courses while making up deficiencies. Thus a student may review all of academic algebra, or geometry, in one year while pursuing college courses in subjects for which he may be prepared. Draftsmen, machinists and others who have acquired a trade will save many hours that are required by the regular student for doing substitute work in the course.

On completing this preparatory course, which is limited to one year, the student may enter the engineering department, and this is frequently done with much of the freshman course completed. The minimum annual expense for tuition, books and general supplies is about one hundred and fifty dollars. No scholarships are available during the preparatory course, but gratuities and scholarships amounting to several thousand dollars are given annually to regular students. There are many opportunities for work in the shops, laboratories and drafting rooms of the college. GARDNER C. ANTHONY.

UNIVERSITY OF ILLINOIS, URBANA, ILL.

Editor MACHINERY:

We enter here quite a number of "special" students—that is, students over 21 years of age who have been out of school for several years, but still are sufficiently prepared to take up our shop practice work. These men frequently spend two years and do a considerable amount of work in our shops. At the end of this time they usually stop and get positions in regular shop work. In order that a student may do this, he requires a fair knowledge of algebra and geometry, some knowledge of shop drawings, and ability to write and spell well. A student coming to us and desiring to take the regular four years' work in engineering always receives credit for any shop practice work which he has had before coming to us—or drafting room experience. This enables him to devote more of his time to making up the mathematics and language requirements, which he usually lacks. It must be emphasized that engineering courses are largely mathematical, and that prospective students in these courses, the regular or special, can receive little benefit from attendance unless they are prepared and willing to attack mathematical studies vigorously.

The charges for tuition here are nominal, and the cost of living, including all expenses of the student both in the University and out, may be easily as low as $225 to $250 a year. Some students come here with only $50 to $75 at the beginning of the year and manage in one way or another to earn enough to get through the year in connection with their regular work. This, however, involves some hard work on their part and frequently detracts from their ability to do first-class work in the class room.

I have had under consideration the advisability of establishing what we might call a two years' course in Mechanic Arts at the University of Illinois, permitting the students to enter it with only the avowed purpose of becoming mechanics rather than engineers. There seems to be very little provision in American educational systems for educating mechanics. I was very much impressed by our lack of this facility from what I saw in some of the German and English schools this summer. I do not believe that it would be for the best interests of the United States to take up this problem with the idea of perpetuating this method of education at the universities, but it might do us until such time as facilities for educating mechanics should be provided otherwise by separate schools.

L. P. BRECKENRIDGE.

UNIVERSITY OF MINNESOTA, MINNEAPOLIS.

Editor MACHINERY:

I send you herewith the bulletin of our engineering college, which will give you an idea of what it costs to attend the University.

You will notice that one student expended a total of $268.83 during the college year, which included board, room, books, clothing and other expenses. Of this he earned $172.50 during the college year. Another man expended $397.09, of which amount he earned $272. In another case a young man was able to put himself through the Junior year on an expense of $217.50 during the college year.

Opportunities are abundant whereby a man may earn a sufficient amount to pay his expenses without detriment to his scholarship. A journeyman machinist or tradesman can easily secure employment during the summer months at the various shops in the vicinity, and is often able to save a sufficient amount to pay one half of his expenses during the college year. Our policy has been to credit any journeyman who may enter the College of Engineering with the whole of the shop work, but we advise that he take the course in pattern making and foundry practice if he has not already had work along these lines.

Provision is made for students who are permitted to pursue special lines of studies selected from some regular course. Such students must be of mature years, and present preparation sufficient to admit them to the Freshman classes. Others who may give satisfactory evidence of ability to do the work applied for may be permitted to enter without qualifying on the entrance requirements to the Freshman classes.

J. J. FLATHER.

P. S. I neglected to state above that credit would be given to those who had technical knowledge obtained in machine and other shops; the amount of credit to be determined in each particular case. This does not refer to the case where a man is a journeyman. J. J. F.

UNIVERSITY OF CALIFORNIA, BERKELEY, CAL.

Preparation required is substantially a grammar and high-school course. One who has not enjoyed the advantages of a high school education might profitably take up any of the engineering courses after doing the work ordinarily done in the high schools in the subjects of mathematics (algebra, plane and solid geometry and trigonometry), physics (with laboratory), chemistry (with laboratory), and free-hand drawing. A student equipped with a fair knowledge of these branches is prepared to take up the full four-year course. Upon the satisfactory completion of such a course, and upon evidence in addition that he has a sound knowledge of the elements of English literature and of the history and government of the United States (such knowledge as is obtained in the high schools that prepare for the University), the student receives his degree.

Tuition is free. The average cost of board and lodging in Berkeley is about $22 per month, or about $175 per college year. It is believed that the average annual expenditure of a student lies between $250 and $300, but it is certain that many students make their way comfortably with considerably less than $250. There are over seventy scholarships available for undergraduates, most of them only for residents of California.

PURDUE UNIVERSITY, LAFAYETTE, IND.

Entrance requirements: Common English branches, including United States history, arithmetic, geography, English grammar and composition, algebra through quadratics.

College expenses: Tuition is free to residents of Indiana and a certain number of non-residents who are able to furnish wholly satisfactory evidence as to character and ability will for the present be admitted upon the same terms. The trustees reserve the right of withdrawing this privilege at any time.

There are no special provisions except the effort to keep the expenses very low, both as to cost of living and University fees.

UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

Editor MACHINERY:

High school graduates in the larger towns should be able to fulfill the entrance requirements without difficulty. If desired to take a special course the student will be examined on the requirements necessary for doing successfully the work after entrance.

A distinction is made between special and partial students, in that the first intends doing all the engineering work in the course and as much mathematics, physics and chemistry as may be required of him. A student who does less than the amount of work outlined above is rated as a partial student. The reasons for desiring a partial course must be stated to the committee in charge and if, in their opinion, the reasons are good ones, the student is allowed to take such a partial course. The actual requirements for admission cover mathematics, including algebra, geometry and elements of trigonometry, elementary physics, English, French or German, and history.

The University has a few scholarships available for students residing outside of Philadelphia who are doing the full work of

the course. These are awarded to needy students, partly on the basis of excellence in passing entrance examinations.

The cost of a year's work at the University would be made up of $200 tuition, $25 caution money to cover breakage, with any balance returned; room in the dormitory from $45 to $105 for the college year; board at the University restaurant at $3.50 per week, and books and supplies, which will average $25 per year, the first year's expenses being a little greater than the average, because of the necessity of purchasing drawing tools.

A few of the students in the technical courses do outside work on Saturdays and at night during the college year, but the regular required work is all that should be done in justice to the student, or more than four years should be taken for the completion of the course.

Knowledge of shop work and drawing would not offset deficiency in other entrance requirements, but after entrance no student is required to do over again those things that he can do well, and a satisfactory knowledge of either would result in setting free certain hours that might be used for outside work, but a non-resident of Philadelphia would be likely to find it a difficult matter to fill such hours with paying employment.

H. W. Spangler.

HARVARD UNIVERSITY, LAWRENCE SCIENTIFIC SCHOOL, CAMBRIDGE, MASS.

Entrance requirements: English, French and German, history, algebra, plane and solid geometry, physics or chemistry, and one or more elective studies.

College expenses: (Including board) $400 to $1,000 a year.

Special provisions: Properly qualified students may be admitted as special students without passing admission examination. There are 45 scholarships ranging from $150 to $400, awarded on the basis of need and high scholarship. Students may offer for admission freehand or projection drawing, woodworking, blacksmithing, benchwork and machine-tool work, in addition to the commonly required subjects.

CASE SCHOOL OF APPLIED SCIENCE, CLEVELAND, O.

Entrance requirements: The common English branches, algebra, geometry, complete; elementary physics and chemistry and one year of German.

College expenses: Tuition, $100; other fees, $5 to $10.

Board and rooms: $4 to $6 per week. In clubs, lower rates can be obtained.

Special provisions: A limited number of good mechanics are furnished work in the shops to assist in paying the students' expenses.

WORCESTER POLYTECHNIC INSTITUTE, WORCESTER, MASS.

Entrance requirements: United States history, English grammar, algebra, plane and solid geometry, English, French or German.

College expenses: Tuition, $150; other fees, $10.

Special provisions: A number of scholarships are available, but they are restricted to residents of Massachusetts.

COLLEGE OF AGRICULTURE AND MECHANIC ARTS, BOZEMAN, MONT.

The preparation needed for the regular course in mechanical and electrical engineering is a complete high school course or its equivalent. For a special course a student must show sufficient ability to carry on the work satisfactorily. Quite a number of students in this institution pay a part of their expenses by doing janitor work or assisting instructors in the various departments. The total expenses during the college year average about two hundred dollars, but this amount can be lowered considerably by clubbing or self-boarding. Credit is given for shop work and drawing, but they cannot be taken to offset deficiencies in mathematics or any other subjects which would be essential in the regular engineering course.

CLARKSON SCHOOL OF TECHNOLOGY, POTSDAM, N. Y.

Tuition, $80 per year, books and apparatus, $30 per year; rooms, 50 cents to $1, and board, $3 to $4 per week.

"Last year and just now we have been able to get sufficient outside work in the machine line so that we could pay from 15 to 20 cents an hour for a good machinist if he were taking the regular course, but we do not advertise any such arrangement, for we are not making that sort of thing a regular business.

"The entrance requirements are the equivalent of a four-year New York State high school course. We can and do, however, take special students, requiring only that they shall have a thorough working knowledge of algebra through quadratics and of plane geometry. The other requirements may be made up after graduation. It would seem to me that it should be a comparatively easy matter for a man who has completed his four years of engineering study to work up the "humanities" required for entrance even while engaged in his professional labors. We do not try to shape our courses to fit such special students, however, and do not exactly encourage their entrance, for the lack of a high school training is, in itself, often sufficient to make it impossible for even a man thoroughly in earnest to carry the heavy work of the engineering studies."

Barton Cruikshank.

STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, N. J.

Entrance requirements: Arithmetic, algebra, plane and solid geometry, plane trigonometry, English composition, United States history, physics and chemistry.

College expenses: Tuition, books, etc., $200 a year.

Board and rooms: $250 to $300 a year.

Special provisions: There are no special courses. A knowledge of drawing and shopwork will offset deficiencies in the requirements enumerated above only in so far as the student who has this knowledge will have more time than those without it to make up his deficiencies. Scholarships limited.

LEHIGH UNIVERSITY, SOUTH BETHLEHEM, PA.

Entrance requirements: English, American history, algebra, geometry, plane trigonometry and logarithms, physics, German.

College expenses: (Including board and room) $298 to $470

Special provisions: There is a system in vogue whereby a student may postpone payment of tuition ($125 per year) until after graduation. Work satisfactorily done elsewhere need not be repeated at the university.

ARMOUR INSTITUTE OF TECHNOLOGY, CHICAGO, ILL.

Entrance requirements: Algebra, plane and solid geometry, trigonometry, mechanical drawing, physics, chemistry, German and English.

Special provisions: "Students who have had experience in drafting or shop work are given credit for these subjects, and to that extent the regular work of the course is lessened. We endeavor to pursue a liberal course toward students needing help and to the extent of our opportunities allow them to work for their tuition."

UNIVERSITY OF MAINE, ORONO, MAINE.

Entrance requirements: Ordinary college requirements in English, one year of foreign language, plane and solid geometry, algebra and two sciences.

College expenses: The annual expenses are: Registration, $10; tuition, $30; incidentals, $20; average laboratory fees, $8, and text books, $15.

Board and rooms: $3.50 to $4.00 a week.

Special provisions: Students can obtain loans from the university covering tuition. Certificates of proficiency in shop work are accepted as a substitute for the work required in the shops. Previous work in drawing will be accepted for the required work in that line. Neither drawing nor shop work are accepted as substitutes for the entrance requirements.

A student may take a special course in mechanical or electrical engineering without taking the examination in the entrance requirements. It would be necessary, however, for such student to show that he is competent to carry on the work which he desires to take. Such a course will not lead to a degree.

UNIVERSITY OF VERMONT, BURLINGTON, VT.

Entrance requirements: Arithmetic, algebra through quadratics, plane, solid and spherical geometry, English grammar and literature, English and American history, botany, political and physical geography, and two years of French or German, or its equivalent of Latin.

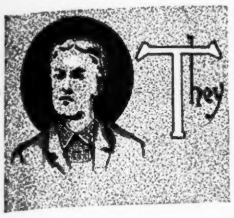
College expenses: $60 per annum for tuition, and $20 for incidental expenses. For students pursuing courses in the shops or laboratories an additional fee of from $10 to $20 per annum.

Special provisions: A considerable number of scholarships, covering the amount of the tuition, are available for students of limited means. The college does not accept a knowledge of shop work or drawing, in place of the regular entrance requirements.

DURING THE NOON HOUR.

A TALK ON TRADE SCHOOLS AND EDUCATION.

W. H. Sargent.



They were eating their dinner around an old box stove—the Round Table of the machine shop.

There were Jessup Steele, the big blacksmith, and Cutler, the toolmaker; Emery, the grinder; Job Smith and John Gage, machinists, and during their dinner they began to talk about getting jobs.

"D'ye see the kid that struck the boss for a job this morning?" asked Cutler. "No? Well, he came in while the old man was turnin' up pulleys and tetered 'round, first on one foot and then on the other, and finally he spoke up: 'Please, mister, I'm in a hurry.' Then the boss looked down and saw him and asked him what he wanted. 'I want a job, sir.' 'Don't believe I've got any work for you,' said the old man, kinder bluffin' him off, for you know he wants a good smart boy. 'Oh, you must have,' said the boy. 'Among so many men you must have work for some boy.'

"'Don't believe I can afford to hire ye.'

"'Try me a month and you can't afford to get along without me.' At this the old man began to weaken.

"'When kin ye come?' he asked.

"'Don't have to come. I'm here now,' said the boy—enough for him, you see.

"'Where's your frock and overalls?' asked the boss.

"'Where's my job,' answered the kid. 'I'll have my togs ready when my job's ready for me.'

"'All right; come this afternoon,' and he was hired as quick as that."

"Now, I'll bank on that boy," said Steele. "If he could get a job out of the old man as quick as that, he's got sand enough to hold the job down all right."

Over in a corner of the shop was a silent man with an Irish brogue, not noticeable during his silence. He had a pencil and a pad of paper on which he was figuring, he being a student in the Scratchall Correspondence School, taking a Complete Mechanical Course. He was so saturated with his studies that he had a habit of thinking and figuring aloud. "That boy," he remarked, "shud have th' advantages uv a technical school instid uv wastin' his time in a shop." "How much better off would he be?" asked one of the men. "Six times, und two to carry," he remarked, absently. "Hey, fwhat's that? How much betther off? Well, how much better off is th' boss than you are, and how much th' propriethor thun the boss?"

"Do you think the boy would be any better off in this shop after he had been through such a school?"

"No, I do'on't, becaze th' man at the hid of this shop wud rather th' boy wud grow up wid the bizness as they say, 'nd then he would think the boy all right since he wud be a miniature copy uv himself."

"Well, anyway, he's some different from the kid that came in here last week. See him? He had on a bad attack of that tired feeling when he asked the boss if he had any work for him.

"'I do all of your kind of work myself,' said the boss."

"'Not enough to keep you busy,' said Mr. Thomas.

"'It won't take a great deal to keep me busy,' the boy replied.

"'I do all of your kind of work myself,' said the boss.

"'Then this is just the kind of a place I want,' said smart Aleck. 'Tried to be funny, ye see. Old man just looked at him kinder witherin' and he withered and has been witherin' ever since."

"You were speaking of trade schools," said a large man, an old sport with a mustache brooding over his mouth like some great national sorrow. He was smoking a T D and the puffing of his exhaust indicated that his condenser was out of order and that he was running temporarily at high pressure. "Now, I've been through a trade school," he said, somewhat condescendingly, "and I know how practical they all are. I have sat all day with a bunch of other fellows under a high-priced professor, watching the water run through a faucet, and estimated how much water, to a gallon, ran through that hole in a day, and we finally reported to that professor that we figured that there would

be four quarts to a gallon!" Puff, puff. "In the blacksmith's shop we learned that we couldn't temper lead nor weld cast iron!" Puff. "Always glad to know them things. Then we worked at pattern making and we learned that the trees didn't grow the right shape for patterns; had to whittle the wood into shape; couldn't pick out a piece with the right crook as we used to when we wanted to make a runner for a bob-sled." Puff, puff. "It was a great comfort to me to learn that! It was worth the whole price of admission!" Puff. "Then we learned to demonstrate, to integrate and to calculate, and look at me now, fifteen dollars in debt! I agree with Shakespeare, or was it Moses, who said, 'With increase of wisdom comes increase of sorrow.' At the Institute it was never admitted but that every graduate would become either a foreman or a superintendent, but I have since learned that there is only one foreman to about ten men, and one superintendent to a hundred, while the rest are 'even as you or I.' One must have a pull to be a foreman and push to be a superintendent. All of those places are filled by men who have friends to boost them, but who have not the education nor the ability that I possess, while I am up here in the woods, dead and buried—(puff, puff), almost."

The workmen looked to the Irishman for some word of vindication for his position, but he appeared intent on his studies and remained silent except for an occasional muttering of "five times four is twenty," until his task was completed, when he turned to the speaker and gave expression to the following: "Ef I was the father of thut promising lad I'd give him all the technical eddication his owld dad cud pay for, even ef I had to mortgage me automobile, and then I'd speak a little baccylarryate out o' me own head. I'd tell him kape his feet down off the desk and not be tellin' his employer fwhat to do nor how to run his own bizness. I'd tache him not to spind too much time calibratin' the orifice of a whiskey bottle! Was ut Shakespeare or wus ut Moses said 'there was two things there was no good kickin' about; one was the things you cuddent help and the ither was the things yez cud help! I'd advise him to keep his eyes open and his mouth shet and to keep his hands busy with his master's work, and I'll risk his ever bein' a dead (puff) beat! Four, eleven, forty-four and two to carry"—and then the whistle blew.

* * *

LETTERS FROM ABROAD.—3.

VEHICLES OF PARIS.

Editor MACHINERY:

Referring to some of the vehicles of Paris, other than the traveling sidewalk, moving staircase, and fast-and-slow (mostly slow) running elevators, mentioned in a previous communication, we find that the balloon is much more strongly in evidence than in this country. By this I do not refer to the lazy captive balloons, several of which float over the Exposition, as they do over agricultural fairs and circuses in America, but to a regular system which has been going on all summer, of Sunday afternoon balloon races, where from half a dozen to a score of these yellow silk monsters will start within a few minutes of each other, from a balloon field in Vincennes Park, going in any direction that a capricious wind might dictate, and drawing prizes for the quickest landing, or the longest journey, as the case might be. Singular to relate, there seem to have been no serious accidents during all these ascensions, although some of the balloons traveled many miles, and had various hair-breadth escapes by land and water.

Hand-carts and small Wagons.

Returning to terra firma we find an unusual variety of vehicles in Paris at the present time. Beginning with doll carriages, baby carriages and wheelbarrows, we find them about the same as in this country, except that some of the last-named humble affairs are made with the wheels set far forward of the body, so that the workman has to bear much more of the load than in our short-built machines. This seems to be in keeping with many other things in Europe, where a man accomplishes a certain object with far more labor than necessary. Vehicles much better known abroad than in America are the street hand-carts and small four-wheeled wagons, loaded not only with fruit, vegetables and fish, as with us, but with wood, coal, hay and miscellaneous merchandise, for distribution and in course of general transportation. These are not so remarkable when drawn by a strong man, and perhaps pushed by another one, even though they are panting and perspiring almost up to the limit of their strength. The more painful aspect of the case is the large number of them drawn by women and girls, although it is true that in many cases these propelling personages are assisted by dogs and goats, especially dogs. In some cases this useful and patient animal is underneath the cart, with the traces attached to the rear end. In many more cases a dog is at one side of the tongue and a woman at the other. As an improvement on this method of propulsion some of these carts and wagons are pulled by small donkeys, the driver usually walking.

In the design and operation of bicycles there is little to see which is different from the practice in this country, there probably being no machine in existence the use of which has so spread all over the world in a uniform manner, and of very nearly uniform mechanical and artistic design. The most noticeable thing in Paris is perhaps the scarcity of the American "scorcher," a majority of the riders resembling more nearly the American gentleman rider, who sits erect upon his machine as if he were on horseback, and who does not lean his head down over the handle-bar with a combined abject-misery and general-defiance-of-mankind expression, as is so often seen among our would-be smart young men at home.

In carts and wagons drawn by horses, mules and oxen, we see in Europe but very little difference from home practice, except that the vehicles are vastly heavier, in many cases weighing perhaps twice as much as they ought to for a given strength. This seems especially foolish when we consider the fact that the roads are, on an average, much smoother than we have them in America, with less danger of break-downs by reason of mudholes, ruts, etc. The harness also seems to be heavier than necessary, especially the horse-collars, which generally terminate at the top with a vast would-be ornamental structure that is something in the nature of a squatty church steeple. In horse-drawn pleasure carriages we see in Europe mostly the same designs as at home, the quality apparently being about the same—but the weight greater.

Automobiles.

Of horseless pleasure carriages, or automobiles, as used in Paris, a volume of descriptive matter might be written. They are of almost every imaginable size and design, from a bicycle with a little gasoline engine in the frame, beneath the seat, to the great tally-ho carrying a dozen or so passengers. There are many tricycles with a motor either on the rear axle or on the head in front, occupied by a single rider. Both these and the bicycles are arranged with pedals for starting, and for emergency riding by foot power. Some of these machines are made to tow a small carriage with a seat for one person. Then there are small buggies, and phaetons, and box-wagons, and every other kind of ornamental carriage, of many degrees of beauty and simplicity, with many more degrees of ugliness and unnecessary complication. Most of them are driven by gasoline, with great corrugated radiators, usually exposed to view, for getting rid of the surplus heat. There are a few steam-driven machines and a good many electric vehicles, the latter, of course, as usual, being the simplest and the least trouble to run, but having the usual disadvantages of great weight and need of frequent charging. A new breed, so to speak, of vehicle owner has arisen in France as well as here (but has probably been there more highly developed than in any other country). He has a disposition something like that of the American bicycle scorcher, but vastly magnified. He drives in complete waterproof garments, with great goggles on his eyes to protect him from the dust and mud which stream over his machine in a foggy shower, as he rushes at a speed of 35 or 40 miles an hour, past, or over, everybody who has the presumption to occupy a road located in the same portion of the earth.

Cabs, and the French "Cabby."

The horse-drawn cabs of Paris are mostly low Victorias, with a high driver's seat, one broad, comfortable seat behind, and a small folding seat in front. The hood is usually folded back, but swings very far forward for use in time of rain. There are but a few of the closed coupés which in London are called

"four-wheelers," and the hansom cabs, which are so numerous in London, scarcely exist at all. The total number of cabs in Paris is some 20,000, more or less, and there is no difficulty in finding them in almost any part of the city. After finding them, however, the first difficulty that arises is to attract the attention of the "cocher," who often drives unconcernedly by, with an air of dignity which excites a curiosity in the mind of the American beholder as to whether he may be some stray emperor or other royal dignitary. Should he be persuaded to look favorably upon his prospective customer or go so far as to pause in his mad career and drive up to the sidewalk, the next difficulty is to persuade him to allow anybody to get in, he apparently not being anxious to do any business unless the drive is to be a short one. Should he be informed of an address which signifies a long drive he is very apt to depart precipitately unless indeed the customer is wise enough to jump in before giving him such address. In this case he is bound by law to go ahead, and will usually do so if there are any policemen in the neighborhood. Otherwise he may stop, take off his hat, and light a cigar, as was once the case with a friend of mine. This gentleman, however, stretched himself back comfortably in the seat, and also lit a cigar, both waiting in the sunshine until a policeman hove in sight and the rear smoker commenced to take down the number of the cab in his notebook, upon which the driver immediately started and made good time to the destination. The cab service was worse than usual this year, on account of the great number of riders who were visiting the Exposition, and on account of the cabmen's strike, which kept a good many vehicles out of commission, so to speak, for a number of weeks. The fares, however, although higher than in other years, are really, from an American standpoint, remarkably low, the price being but a franc and a half (30 cents) for any distance within the limits of the city proper. This, in some cases, gives several miles travel for the sum mentioned, which is generally supplemented by a "pourboire" to the driver of anywhere from 10 centimes to a franc, according to the distance. The rider is not required by law to pay this, but finds it advisable to do so, in the interest of good feeling and the avoidance of much horrible French profanity. The price mentioned is for the use of the whole cab, which usually holds from one to three persons, but the compensation is no greater if it carries five or six, which is sometimes the case. In spite of its drawbacks, and the somewhat surly disposition of many of the drivers, the cab system of Paris is, on the whole, a remarkably good and convenient one, and is certainly conducted on the rapid transit idea. In this respect it is in marked contrast to the other methods of urban transportation. Indeed, it has seemed to the writer more than once that perhaps the cab driver was the only man in Paris who was ready to do business immediately and quickly, after the plan of the American "hustler."

In addition to the cabs above mentioned, which are mostly owned by several large companies, there are in Paris a few automobile cabs, chiefly of two kinds, operated respectively by gasoline and electricity. These, however, command such prices that they are but little used except as curiosities. Some of the charges are as high as 100 francs per day.

Street Railway Cars.

The omnibuses and street cars, or trams, as they are termed abroad, may fitly be classed together, as in many cases they look very much alike, and sometimes occupy the same tracks. Of course, most of the omnibuses have ordinary wheels, and run on any kind of a road; some, however, have wheels slightly concaved upon the edge for running upon a car track, although they can also run elsewhere. The trams proper have flanged wheels, but the flange is quite narrow, and the track usually has but a small groove in the rail, which does not interfere much with the flat surface of the street. These vehicles are most of them two stories high, with a narrow, winding staircase at the rear, much the same as in the London omnibuses. The upper seats are sometimes regularly enclosed, but oftener covered simply with a canopy. Both the omnibuses and the trams are driven in a variety of ways, the most common being by three horses abreast, or sometimes five, with three leaders in front. Others are driven by steam, in the regular fashion, with a small vertical boiler and double engine on the front platform. Still others are steam-driven from a reservoir of hot water, under pressure, situated beneath the body of the car. Others are driven by compressed air, and some, I believe, by a combination of steam and compressed air, but these I did not investigate. A majority of vehicles of this sort seem to be driven by gasoline, with various types of apparatus. The storage battery is also in evidence for the electrically-driven machines, and many trams are driven by underground electrical conductors, on the slot system, much the same as in New York. Others are provided with overhead trolley wires, in some cases the current being taken off by a side bearing metal rod, or by an underneath bearing metal loop, rather than by a trolley wheel in a forked pole. The latter, however, is also quite common, but many of the best cars are of American construction.

On the whole, the omnibus and tram-car system of Paris seems to be a curious conglomeration of very many kinds and conditions of vehicles, both as regards architectural design and mechanical methods of propulsion.

Viewed commercially, as having rides to sell which the foreign tourist wishes to buy (such tourist being perhaps handicapped by an imperfect knowledge of the language and of the geography of the different complicated routes over which these vehicles run), the whole system is extremely exasperating, and is apt to give an impression to the would-be passenger that they will never let him get in when he wants to, and never let him get out when he is ready, and never take him where he wants to go. The well-known "complet" signs hung upon the omnibuses are well calculated to give rise to the old joke of the American backwoodsman, who lamented that when he was in Paris he never visited one place (Complet) where all the omnibuses seemed to go. In spite of the great number of the vehicles in question, distributed over a large portion of the city, the fact remains that (this year, at any rate) it is very difficult for a foreigner who does not speak French to get a vehicle when he wants it, or to know where he is going after he gets it. Even if he does speak the language he is subjected to long and tedious waits before being allowed to enter an omnibus at the terminus, having to secure a number and wait until his turn comes, the vehicle then waiting until it is full, instead of starting at a regular time. After starting, the troubles are not yet ended, for at each change of vehicles at points of junction, other delays are made unnecessarily, a row of passengers sometimes having to pass tediously through gates, and wait until a gendarme with drawn sword in hand will kindly allow them to enter the new vehicle which is waiting for them.

The regular suburban railways in the vicinity of Paris are perhaps operated as well as in any other country, there being no particular difficulty in going where one wants to. A belt line running around the city affords many conveniences in this respect. Most of the trains are drawn by ordinary locomotives, but there are now being installed a number of powerful electric locomotives. The same company owning these has for emergencies, in case currents should give out, several locomotives driven by compressed air stored in a number of large cylinders. These are very heavy and elaborate machines, but as yet have not been put into use to much extent.

The only aquatic thoroughfare in Paris is, of course, the Seine, which, with its tributary, the Marne, extends entirely through the city, from east to west. There are numerous wharves on both sides of the river, at which passengers can take small steamers at short intervals. The fare upon these boats is very cheap, amounting to but ten centimes (two cents) or so for short trips. The boats make good speed, but are rather ugly in appearance, chiefly on account of the great number of advertising signs which are displayed upon them. There are in Paris as yet but few electric and naphtha boats, such as there are being of small size. The tendency, however, seems to be to increase their number in the near future.

OBERLIN SMITH.

* * *

An apparently flourishing industry in Eastern manufacturing towns is washing suits of overalls and aprons for machinists and factory operatives. For the small sum of fifteen cents each, suits of overalls are collected, washed and returned in time for the following week. Laundrying overalls in this way is popular with the men and, undoubtedly, with their wives and mothers.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

A HANDY MUSHET TOOL—CENTER INDICATOR.

"Nemo." describes a handy tool holder and a center indicator. Fig. 1 shows the tool and holder, which is easily made and which can be dressed on an emery wheel, no forge being required. Take two pieces of ¾″ square "cold rolled" steel, about 6′ long, clamp them together and drill a ½″ hole through the whole length as shown at B. For the tool use ½″ round mushet steel. If the holder does not clamp the tool hard

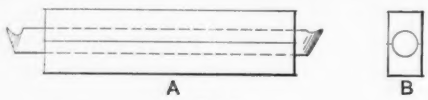


Fig. 1

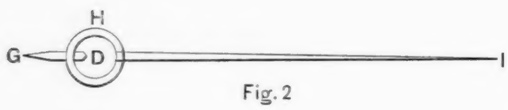


Fig. 2

Fig. 3

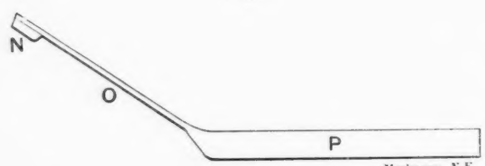


Fig. 4

enough file it where the two pieces come together till it does One end of the tool can be ground as a "diamond point," the other as a "round nose," or finishing tool. If preferred, one end can be ground right hand and the other end left hand. Thread tools, brass tools, etc., can be easily made and used with this tool holder. Holders can be made smaller to take ⅜″ round mushet or large enough to take larger steel, the size depending on the size of the lathe tool post. These tools work equally well on a planer or shaper.

To make the indicator, first make a steel ring H, Fig. 2, about 1″ inside diameter and 1¼″ outside and ⅜″ wide. Drill and tap two holes diametrically opposite. The short spindle G is a piece of steel ¼″ wire about 1½″ long, both ends pointed; one end is threaded and screwed into the ring, entering the ring ⅜″ or so, as at D. The long spindle I is threaded and screwed into the ring, the other end having been tapered for half of its length, which should be at least 9″. This spindle can be made of steel, but aluminum wire would be better, as it is lighter and will be more sensitive. Take a piece of steel, say ⅝″ x 1½″, and draw out one end to a flat spring O, 1-16″ thick and ½″ wide, about 4 or 5″ long, with a boss N on the end, Fig. 4. Make a center punch mark in the center of the boss N and the indicator is complete. To use it, put the part P, Fig. 4, in the tool post with the center punch mark N resting against the point D, Fig. 2, and the point G on the center of work.

PIPE CENTER OR SPIDER.

H. M. C. sends a sketch and description of a pipe center or spider that varies somewhat from the ordinary type. It is adapted for large cast-iron cylinders, pipes, pipe fittings, etc. If made of the dimensions and proportions indicated, it will take a variation in diameter of about 4″. The body A is made of iron or steel and should be turned all over with a nice center drilled and reamed as shown at C. Four holes are drilled and tapped in the periphery of the disc A for the adjusting screws B B B B. The heads of these screws are each turned with a washer bearing D and the stud C, to receive the washer E. The washer is made square and about 1-16″ thicker than the length of the stud C. The adjusting screws may be made conical as shown at F, but the first method is preferable. The usual method of setting the spider is by ball-end calipers, but if the outside is turned with the center it may be set from the outside with ordinary inside calipers.

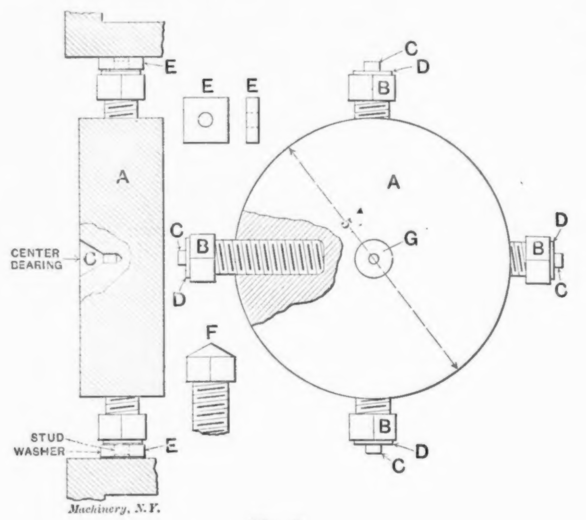


Fig. 5.

[We consider that in a device of this kind it is highly desirable to have no loose parts to become mislaid and lost, and to secure that condition it will be necessary to have the washers swiveled on the adjusting screws, so that they will be retained in position when the spider is removed.—EDITOR.]

IMPROVED BELT AWL.

We have received the following kink from our contributor, W. H. Sargent, who writes as follows: "By permission of Mr. Horner, of the tool room at Fairbanks' Scale Works, I am sending you a sketch of an improved belt awl which he has been making for the repair department of that concern.

"The ordinary form of awl is a source of great inconvenience and often of danger while one is climbing about among moving belts, hanging on with his teeth in order to use both hands.

"Not much talk goes with the drawing. The first view shows the tool in section, the handle being of metal, hollow, with a knurled grip on the outside. The awl may be of the size and shape preferred by the workman and may be sharpened if desired. This awl is provided with a short threaded hub by which

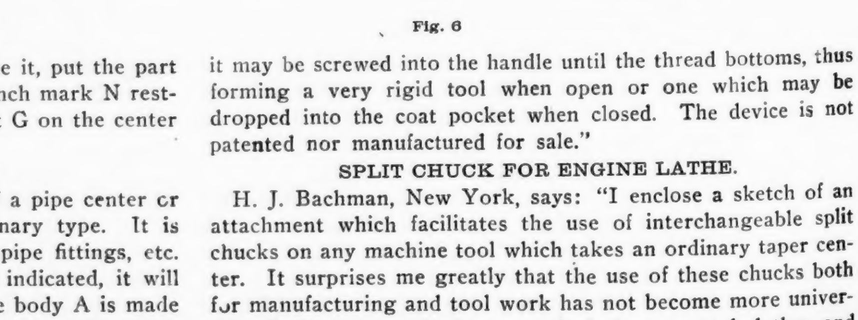


Fig. 6

it may be screwed into the handle until the thread bottoms, thus forming a very rigid tool when open or one which may be dropped into the coat pocket when closed. The device is not patented nor manufactured for sale."

SPLIT CHUCK FOR ENGINE LATHE.

H. J. Bachman, New York, says: "I enclose a sketch of an attachment which facilitates the use of interchangeable split chucks on any machine tool which takes an ordinary taper center. It surprises me greatly that the use of these chucks both for manufacturing and tool work has not become more universal. It is now used almost exclusively on watch lathes and screw machines. I fail to see the reason it is not applicable

to engine lathes, milling machines, grinders, etc. I have found it to be a most valuable attachment when used on the dividing head stock of a milling machine, and when used on the live spindle it will hold small drills, center reamers, and laps, very rigidly. By this method I have been able to drill index plates and equidistant holes in jigs with absolute certainty. It is almost impossible to prevent a drill from running out of true if it

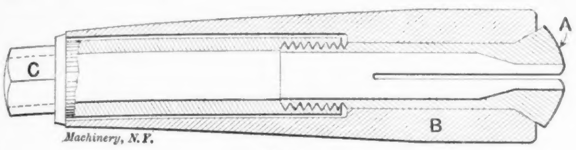


Fig. 7

is held in the ordinary way. Its convenience when used on a universal grinder cannot be overestimated. It will grind small drills, reamers, broaches, and any other work which cannot be held between centers. It does away with the use of dogs, thereby allowing the use of the emery wheel close up to a shoulder. For an engine lathe with a hollow spindle a long tubular socket wrench may be made to tighten and release the work without the necessity of driving out the arbor."

CENTER INDICATOR.

G. W. Freeman, Lynn, Mass., sends a sketch of a simple center indicator similar to the one illustrated in the November issue, but more easily constructed. A piece of No. 18 steel wire about 15" long is bent to the shape shown in Fig. 8, at C. The ends are sharpened and the end next to the faceplate should be hardened. The holder A is made from any conven-

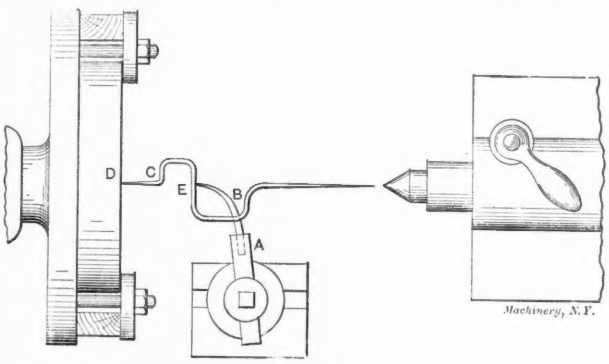


Fig. 8.

ient piece of iron or steel of about the same size as the tools used in the lathe; a worn-out tool will do very well. A hole is drilled in the end in which is inserted a short piece of sharpened drill rod B. The sharpened point rests in a small prick mark on the back of the wire at E. The bend in the wire furnishes the necesary amount of spring which all center indicators should have to work well.

CENTERING TOOL FOR LATHE WORK.

In that last resort of the unfortunate, whether artisan or scholar—the pawnshop—the tool here shown was noticed for

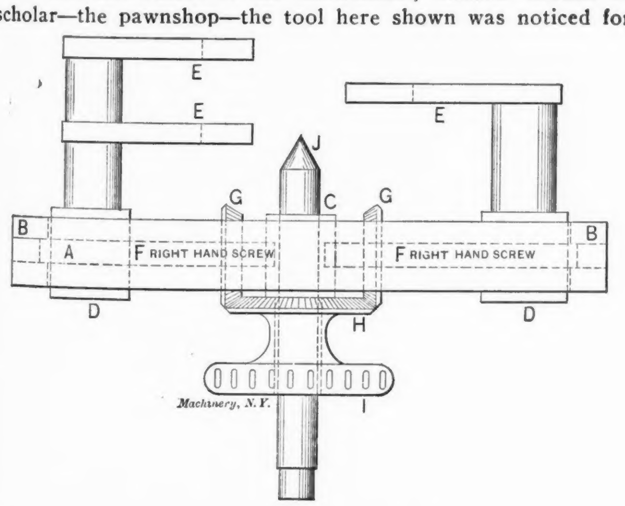


Fig. 9.

centering lathe work. It is a tool most carefully made and evidently a relic of the times when the first-class machinist carried a miniature machine shop in his tool-chest. The cut shows the idea so clearly that little explanation is necessary. The frame, which is about 6½" long, is made of the two pieces A A held in parallel position by the end pieces B B and the center C. Fitted between these pieces A A are the sliding blocks D D, carrying the centering arms E E. Threaded in the sliding blocks are the two right-hand screws F F (not right and left as might at first be thought). The screws have, mounted on their inner ends, the small bevel gears G G which mesh into the larger gear H. The gear H is mounted on a hollow shaft carrying the hand wheel I. The turning of the hand wheel opens or closes the centering jaws on the work, and in the latter case of course brings the center punch J in line with the center of the piece. If after centering with the punch, a drilled and reamed center was wanted, the punch could be removed and the proper tool inserted in place and turned by a hand brace.

A LATHE TOOL—COMBINATION DIVIDER AND CALIPER.

"S. Wrench" says: "I recently saw two handy tools which may be of general interest. One, shown in Fig. 10, was for the lathe and was used for boring and tapping shallow holes of comparatively large diameter, in castings like caps, etc. The body of the tool A was grooved with four slots alternating at the opposite ends. The slots at one end were fitted with the reamer blades B B B B, which sized the hole before tapping. The slots in the other end were fitted with the thread cutters

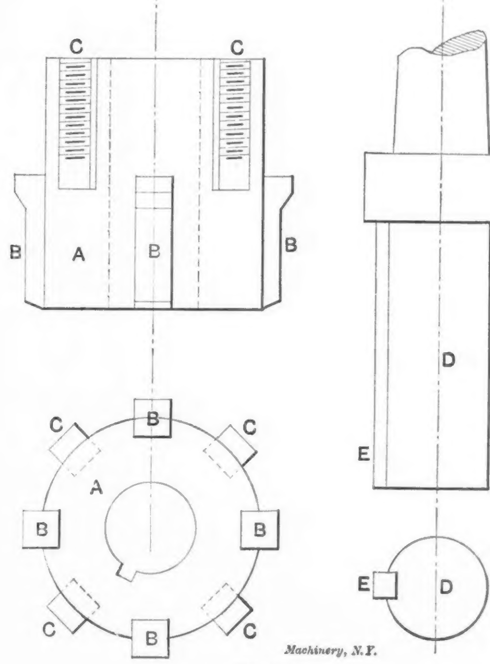


Fig. 10.

C C C C, for tapping the hole. The body of the tool was fitted on the shank of a center in the tail spindle, a key and keyway being provided to prevent its turning. The use of it was simple, consisting of reversing the part A on the shank for the alternate operations of reaming and threading.

The other tool referred to is shown in Fig. 11 and consists of a three-legged caliper and divider which can be used in va-

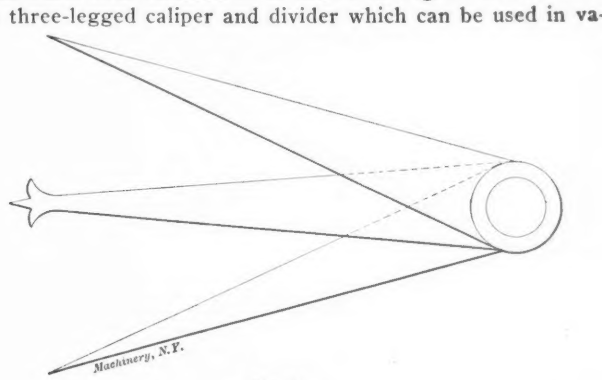


Fig. 11.

rious combinations as a hermaphrodite caliper or divider. It is very handy for centering work having ends of two dimensions, etc.

LETTERS UPON PRACTICAL SUBJECTS.

A USEFUL FORMULA—AN EFFICIENT THREAD TOOL.

Editor MACHINERY:

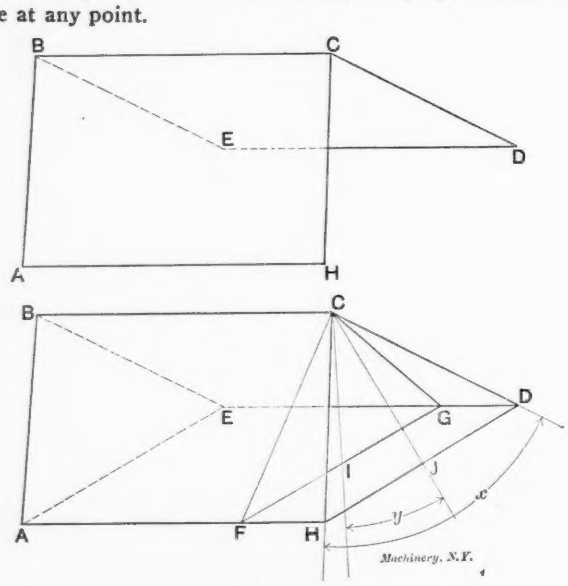
The formula which is given in this article is one which is of use to both draftsmen and tool makers. The writer has had occasion to use it in the past, and thinking others may have the same need, offers it, together with the method of deducing, to the readers of MACHINERY. In order that they may have a clear understanding of all geometrical terms used, a few definitions will not be out of place.

I. If two planes meet in a straight line, the figure formed is called a dihedral, Fig. 1.

II. The line in which the two planes intersect is called the edge of the dihedral B C, Fig. 1.

III. The angle between two lines perpendicular to the edge at the same point is called the plane angle of the dihedral H C D.

IV. The plane of a dihedral is a plane perpendicular to the edge at any point.



Figs. 1 and 2.

We have a dihedral A B C H D E, Fig. 2, which is cut by a plane C F G, at an angle y with the plane of the dihedral. The angle between the lines CF and CG=z. What is the plane angle?

We now have the angles z and y known; we must find the angle x. Let us suppose the width across the base of the triangle C H D = m; then it is obvious that this width is the same throughout the figure, because E D and A H are assumed parallel to B C. We now have F G and D H = m.

$$\frac{\frac{1}{2}m}{CI} = \tan \tfrac{1}{2}z; \text{ therefore } \tfrac{1}{2}m = \tan \tfrac{1}{2}z \times CI \text{ and}$$

$$m = 2 \tan \tfrac{1}{2}z \times CI. \qquad (1)$$

Again, we have

$$\frac{CI}{CJ} = \sec y \text{ or } CJ = \frac{CI}{\sec y} \qquad (2)$$

Again, we have

$$\frac{\frac{1}{2}m}{CJ} = \tan \tfrac{1}{2}x \text{ or } \frac{m}{2\,CJ} = \tan \tfrac{1}{2}x \qquad (3)$$

The length of the line C I may be assumed in all problems of this kind; that is, the distance from the vertex to the middle point of the base of the triangle C F G. The reason why we may assume this length is that its numerical value has no effect on the final result; in this solution we assume its length to be unity. (If we were using logarithms, however, we would assume its length equal to ten, as its logarithm would be unity, provided we were using the common system).

Now we have from formula (1) $m = 2 \tan \frac{1}{2}z \times CI$

From formula (2) we have $CJ = \dfrac{CI}{\sec y}$

Substituting the assumed value of C I in these formulas we have

$$m = 2 \tan \tfrac{1}{2} z \text{ and } CJ = \frac{1}{\sec y}$$

Substituting these values in (3) we have

$$\frac{2 \tan \frac{1}{2} z}{\dfrac{2}{\sec y}} = \tan \tfrac{1}{2} x = \frac{2 \tan z \times \sec y}{2} = \tan \tfrac{1}{2} x$$

Striking out the factor 2 in both numerator and denominator, we have

$$\tan \tfrac{1}{2}z \times \sec y = \tan \tfrac{1}{2}x \qquad (5)$$

Formula (5) then is the required result, giving us half the plane angle of a dihedral, when we have a plane passing through this dihedral at any given angle to the plane of the dihedral.

Practical Applications of the Foregoing.

We now come to the practical application of this formula. The first case is the finding of a plane angle of a piece of triangular stock which, when cut on the top at an angle of 18° to the plane, will have an angle between its sides of 60°. (It might be said here that the above work has been given for those who wish to know how the formula is deduced.) Fig. 3 gives the side and top view of the piece of stock mentioned. The top view, it will be noted, is taken perpendicular to the cutting plane. This is done in order that the reader may not be confused when the angles are used in reference.

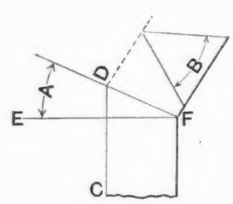


Fig. 3.

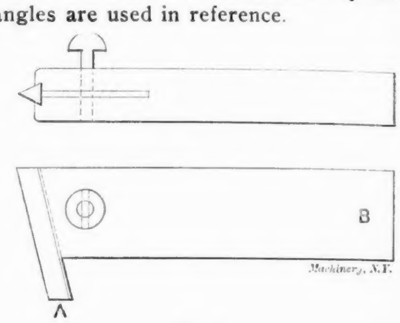


Fig. 4.

The angle A in Fig. 3 corresponds to the angle y in formula 5, and the angle B in Fig 3 corresponds to the angle z in formula 5. In this case the angle A was to be 18°, as stated above, and the angle B was to be 60°, the angle of the U. S. standard thread, and it is desired to know what angle the stock must be when the protractor is placed perpendicular to the edge C D, Fig. 3. It is probably clear that the angle shown at B is not the same at the angle measured along the line E F. If not, a reference to Fig. 2 will show clearly that the angle between G C F (which corresponds to B in Fig. 3) is less than the angle D C H (which corresponds to the angle measured along the line E F, Fig. 3).

Applying formula 5 to the solution of this problem, we have the following:

$\tan \frac{1}{2}z \times \sec y = \tan \frac{1}{2} x$ $\quad \frac{1}{2}$ x is the angle to be found.

$$z = 60° \tan \tfrac{1}{2}z \text{ (or } 30°) = .57735$$
$$y = 18° \sec y \text{ (or } 18°) \;\; = 1.0515$$

Substituting these values in our formula we have $.57735 \times 1.0515 = .60708 +$ which is the tangent of the required angle. From a table of tangents we find the angle corresponding to .60708 is 31° 15'. This, then, is half the angle, between the sides of the tool, when measured perpendicular to the edge. The whole angle, then, must be 62° 30' or 62½°. This is as near as can be used in the shop. By interpolating, however, we may find a more accurate result, and the angle proves to be 62° 31' 20".

An Efficient Thread Tool.

Fig. 4 is a side and top view of the tool and holder complete. A is the cutter and B is the holder. This tool was designed by a tool maker for cutting taps, and an offset holder was not needed. Such a holder could be easily made, however, if the work required it. It will be noted that the cutter is held in place by friction, a method which holds the cutter firmly in place for all cutting; but in case of accident, or should the cutter "bite" it will slide out of place without breaking the tool, thus saving both time and trouble of regrinding the cutter. The tool shown is in use for cutting very small taps, but the general design may be applied to any size tool. The writer claims nothing original in speaking of this tool, as it was de-

signed by another person, but thinking it may be of use to toolmakers in general, gives a description of the same for their benefit.

In Fig. 5 is shown a second application of our formula. Let us suppose we have a worm-thread tool to make, as shown in the upper sketch at A. The clearance angle B is to be 15° and the angle between the sides as shown at C equals 29°. Now we may get the clearance at B by setting the tool in a planer shoe, as shown in Fig. 5. But if we do this and set the head over 14½° each way from the vertical, the angle on the face of the tool will be too small, because the face of the tool is not setting at right angles to the cutting line of the planer. At what angle

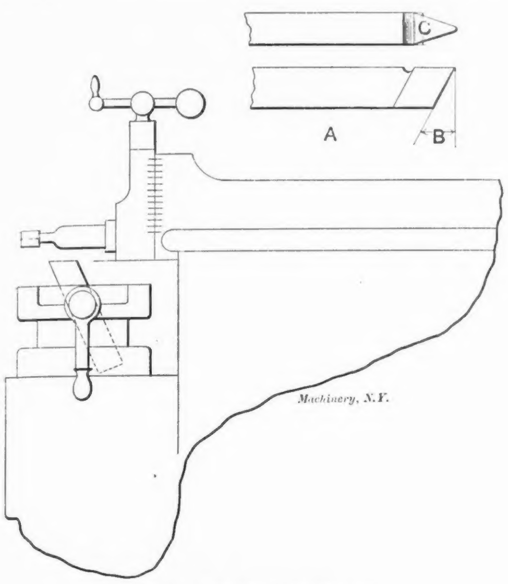


Fig. 5. Practical Application.

must we set the planer head, then, in order that the face angle of the tool shall be 29°? Refer again to formula 5.

$\tan \frac{1}{2} z \times \sec y = \tan \frac{1}{2} x$. In the present case $y = 15°$ and $x = 29°$. $\sec 15° = 1.035$. $\tan 14° 30' = .2586$. $.2586 \times 1.035 = .26765 = \tan \frac{1}{2} x$ or the tangent of the angle which we must set the head each way from the vertical. From the table of tangents we find the angle corresponding to .26765 is 14° 59'. Therefore if we wish to plane a cutting tool which shall have a clearance angle of 15° and a face angle of 29°, we must set the head over 14° 59', or almost 15°, in order that our cutter shall measure correctly when finished.

These two cases serve to show the application of the formula in an elementary way, but by the use of analytic geometry it may be applied to curves of any form, for which we have a formula, and also to a great many for which we may not have a formula.

J. A. Pratt.

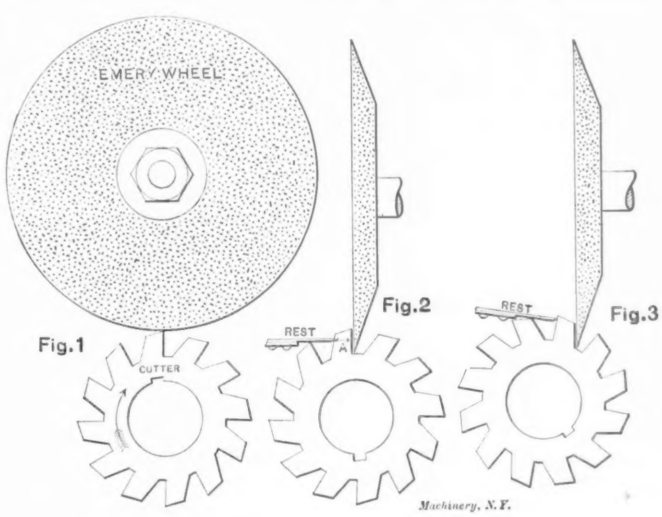
Providence, R. I.

* * *

METHOD OF GRINDING GEAR OR OTHER CUTTERS TO KEEP THEM TRUE.

Editor Machinery:

The accompanying sketches show an easy method of truing gear cutters as well as profile cutters used in milling machines. These cutters are seldom or never true when new, consequently only a few teeth do the cutting, whereas by truing the cutter so all the teeth cut, much coarser feeds can be used, and a great amount of time saved. When the cutters are ground as I will explain, it is an easy matter to keep them perfectly true at all times. Fig. 1 shows the new gear cutter on a stationary arbor. The idea is to turn the cutter by hand slowly under a revolving emery wheel, being careful to have the points of all teeth spotted until the point of the tooth which is lowest barely touches. The next move after doing this to all cutters, is to grind all of the teeth except the lowest one, by using the heel of each tooth against the guide or rest, and slide the cutter back and forth on the stationary arbor, as shown in Fig. 2, until the spots are ground off. Care must be taken to grind the faces of the teeth radial and so that the spot made by the first operation is ground away entirely, without grinding any more than to just remove this spot on each tooth. We have now a perfectly true cutter and each tooth will do its share of the work. Now in order to make it an easy matter to sharpen the cutters and keep them true, it is only necessary to reverse the cutter on the arbor and grind spots on the heel of each tooth, sliding the cutters with face against the rest, as shown in Fig. 3. Of course it is obvious that after finding which of the teeth is narrowest at A, Fig. 3, and just barely grinding



the black off of this heel, the cutter should not be moved to the right or left of face of dished emery wheel; this in order that each tooth will have the same thickness. After this operation the cutter is in good shape and can be kept so by simply grinding the faces by sliding the cutter on the arbor with the ground spots on the heels touching the rest.

Harry Ash.

* * *

CAMOLOGY.

Editor Machinery:

A cam is a part of a machine by which any desired motion during the revolution of a shaft may be communicated to a lever, a sliding bar, or a rod. Fig. 1 illustrates the method by which the outline of a uniformly moving cam giving instant return of rod may be obtained.

First, determine the amount of travel required from A to B. Divide this space into a convenient number of spaces and from same draw complete circle spaces. Divide the circumference into the same number of spaces locating radial lines. The step conjunction of the circular and radial lines denotes the required outline. The motion thus communicated to the rod C is the distance from B to A at a uniform rate during one revolution of the shaft D. The return of the rod C to B is accomplished by a spring, or in some cases, by its own weight.

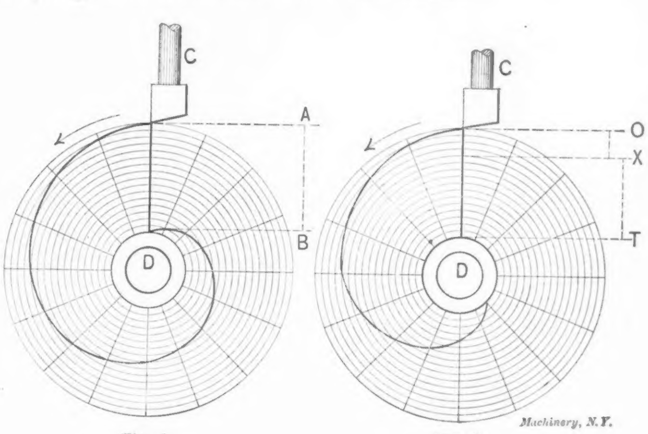


Fig. 1. **Fig. 2.**

Fig. 2 represents a cam whose total throw is the distance from T to O. The rod C rests during three-eighths of one revolution of shaft D. Following the period of rest, the rod C moves at a uniform rate from T to X in three-eighths of one revolution of the shaft, then it moves at a uniform rate from X to O in one-fourth of one revolution of the shaft. On reaching O, the rod C returns at once to T with practically no loss of time.

Boston, Mass. F. W. Clough.

HELP WANTED.

Editor MACHINERY:

Perhaps no part of the various mechanical journals is looked at with more interest, by the average mechanic, than the column devoted to advertisements under the above heading. The reasons for this are twofold: First, they may be regarded, in a sense, as a business barometer, showing the condition of the labor market. Secondly, so long as "hope springs eternal in the human breast," so long will men desire to better their material condition. This is well, for without personal ambition there is little incentive for special exertion to better oneself in one's calling.

There is much uncertainty about a "Help Wanted" advertisement, both for the advertiser and the respondent; an uncertainty that may develop into vexation and positive loss for the advertiser, who, not being gifted with omniscience, makes the best selection that he is able, while the fellow who replies knows that he does so with anywhere from one to two hundred others and must follow up the answer, if he is lucky enough—I think lucky is the right word—to get an answer, as best he may.

Now comes the trouble. If he replies giving detail of experience in full, so often requested, what's the limit? How little will be accepted as covering the case? Must he give each and every change of position and work he has ever made from way back and the reasons for such changes? Is it not likely there are some things he would like to keep back, for personal reasons? Must these be given as well? Now if he has sense enough to fill the place, he will recollect that the less said is the quickest read; there's a proper and better time for all these matters later. References? Yes, but not necessarily a dozen of them, and even the persons mentioned do not like to be troubled without reason. Salary expected? Of course, and he expects, or ought to expect, all he is worth; his time is his capital, and his to sell. Naturally he wants to sell to the highest bidder; higher than the present, or else he would not answer advertisements. A high-priced advertisement is not meant for a cheap man, usually.

Then, too, in replying to a "blind" advertisement, he may be writing to his present employer or some one who may inform him, to his detriment, or he may be working up a position, the locality, conditions or circumstances of which are such that he would not knowingly accept on any terms. Blind advertisements are not good advertisements—for the respondents; there's always an element of suspicion about them. It is really a very difficult matter for a person to write details and particulars concerning himself, especially in view of a possible situation, without conveying the impression of boasting on one hand, or understating the facts on the other; in either case doing but little good for himself.

It is natural for a man to put his best foot forward, to show himself in the best possible light, to make those things prominent in which he thinks he excels, and to neglect others equally pertinent but which might be to his detriment. Hence one's own opinion and statements are likely to be unconsciously colored, in spite of adherence to what the writer believes to be the truth.

Why is it that when a man wants to purchase a valuable machine, he goes to the builders—if possible, makes inquiries, tests the machine in every way he may know of and thoroughly satisfies himself as to its points and merits, but when he wants a man whose services are likely to be of more value than an inanimate piece of mechanism, he hires him from a distance frequently, depending largely on his own statements or those of his friends, and seldom subjecting him to anything like a test or taking the trouble to go and see him where he is best known, i. e., the place of his present or last employment?

The writer of these lines thought he had, at one time, a panacea for some of these troublesome uncertainties. It consisted, briefly, in gathering together, in orderly manner, the addresses of seekers of employment for various positions, getting from them a statement of their experience and all matters connected with themselves that would have any possible bearing on such a situation as they desired to obtain, then verifying their references and even going so far as to look up the applicants themselves by means of local agencies. Then, as openings offered, a man could be selected from these lists, whose application was practically unbiased and whose abilities were considered genuine, as their statements were not made up for any special occasion, and had been carefully inquired into, to the extent that we could recommend our man to be reasonably satisfactory. It was a fine scheme, theoretically, but in practice did not work successfully. Employers were pleased with our efforts but employees did not take kindly to it; in fact, so much suspicion was attached to our attempts that the matter died in its early infancy. Since then—and possibly before—others have tried along our lines with varying and unsatisfactory results.

A clearing house for mechanics may some day, possibly, become a reality, but it entails an amount of confidence in human nature not now existing. W. E. W.

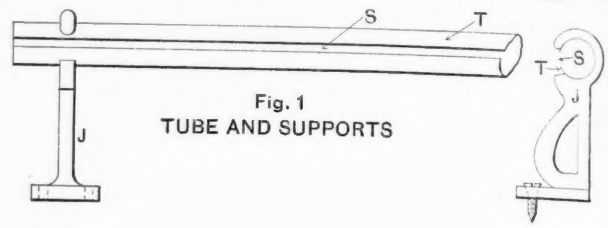


Fig. 1
TUBE AND SUPPORTS

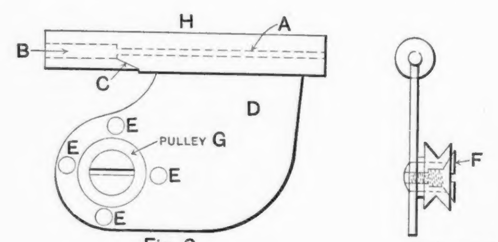


Fig. 2
WIRE GUIDE

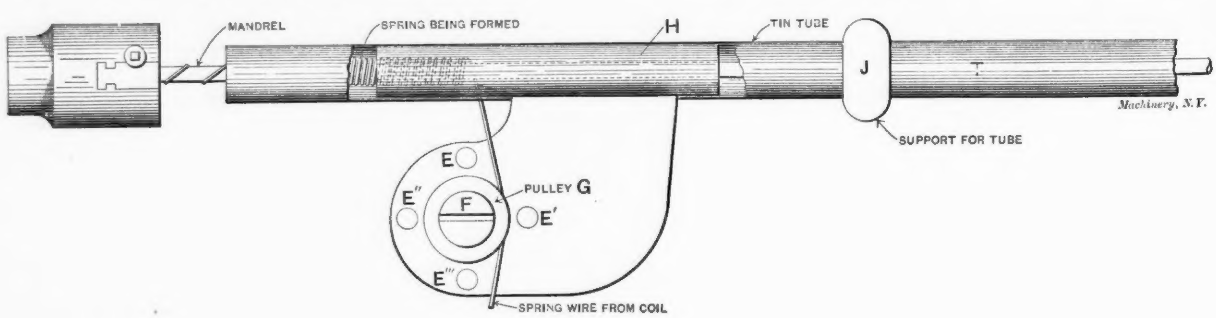


Fig. 3.

RIG FOR WINDING SPRINGS.

Editor MACHINERY:

Being much interested in the winding of springs in large quantities, and seeing the article in the November issue of MACHINERY on this subject, I take the pleasure of sending you a description of a device that I think is superior to a great many that I have seen.

In Fig. 1 we have the tube in which the wire guide slides, and one of its supports, and in Fig. 2 the wire guide. The tube is made from a piece of tin T by bending about a cylinder and has a slot S as shown for the part D of the wire guide to slide in . The supports J J, etc., are soldered to the tube and screwed to a long board which rests on the shears of the lathe. They are of a height sufficient to bring the centre of tube in line with the lathe centres.

The wire guide is made from a piece of round steel rod with a piece of sheet steel of the shape shown at D, soldered to it. The hole A is drilled just to take in the wire mandrel, about which the spring is coiled. A slot is cut with a milling cutter or saw about 1-16 inch wide and clear through to the center, leaving the closed end with the incline c as shown. The end B of the hole A is then enlarged to the size of the finished spring. The part D then is drilled and tapped as shown to take the screw F for the pulley G. By moving G to the left to E" we can get a very tight spring or by moving it to right E' we can get a loose spring. Any toolmaker can tell about the right place for the holes E E', etc.

A sketch showing the top of the rig when ready for coiling springs is shown in Fig. 3. The mandrel or wire about which the spring is wound is gripped in a chuck on the speed lathe. The board with its tube is placed on the shears and the wire guide run up to the end nearest the chuck. The spring wire, which is wound about a reel set at the side of the lathe head, is started in the lathe while running at full speed, until it catches and then is placed in the pulley and let run until it comes to the end of the arbor.

The incline on the end of slot c is made so that one layer of wire will not wind over the other in starting the spring. This fixture winds a perfect spring and can be made very cheaply.

TEDDY.

* * *

A "PUTTING-ON TOOL"—BROACH.

Editor MACHINERY:

All mechanics are familiar with the old joke about the "putting-on tool" and here is what took the place of one in my case. We had in our shop a new set of reamers. A 1 7-16" reamer was used to ream out a 1 13-32" hole in a casting, but with disastrous results. The iron was hard as flint and the "handy" man at the drill press forced it through the work regardless of consequences. The result was that the hole was undersize and the reamer ground off about .300 below size. It fell to my lot to fix it, if it could be fixed. We did not care to send it to the blacksmith shop to be upset because it was a fluted reamer cut with a left-hand spiral. The method I followed to enlarge the reamer was as follows: A blank cutter was made with a forming tool of the same shape as the original cutter used in cutting the reamer shown in Fig. 1. This blank cutter or disc was hardened as hard as fire and water could make it. The reamer which had been annealed was then put on the centers of the milling machine, as in Fig. 2, with the hardened disc in the position shown. The rounded side of the disc was reversed and pressed against the cutting edge of the reamer just opposite to the position it would have if milling the reamer. The table was then raised so as to force the tooth of the reamer against the revolving disc, which was well oiled. The result was that as the reamer was fed along, the edges of the teeth were successively forced outward from the center. Three successive operations around the reamer swelled the diameter .016. After hardening, the reamer was ground to size. It is obvious that the milling machine should be set for cutting the same spiral as that of the reamer.

A in Fig. 3 shows a side view of a broach which was made for cutting out the holes in three cast steel flanges for a steamboat. The holes had been cored out for a ⅝" bolt instead of a ¾"; hence the necessity for enlarging them. The broach was made with six steps as shown at A, and with the steps numbered at B. Step 1 acts as a pilot and to scrape out the sand: step 2 cuts on four sides somewhat as shown at 2 at C; step 3 cuts the hole slightly larger in the same manner; the next three steps cut out the corners as shown in 4, 5 and 6.

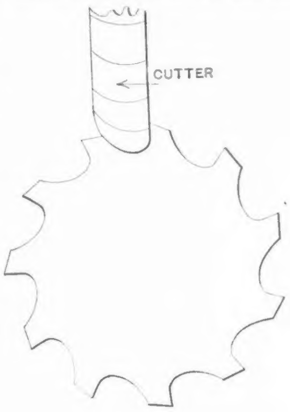


Fig 1.

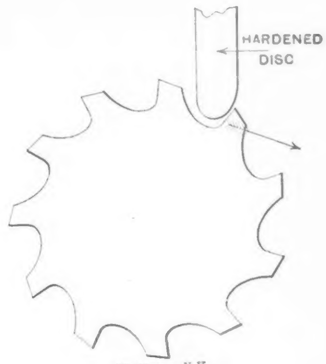


Fig. 2.

There were 90 holes in all, one half of which were through metal ½" thick and the other through metal ⅝" thick. It took about three hours to broach them out, driving the broach with a sledge, as no press was at hand. The operation of making the tool took about 1½ hour on the milling machine, using an end mill.

E. J. B.

Dubuque, Ia.

* * *

TURNING AND BORING CAST GEARS.

Editor MACHINERY:

We make quite a few miter gears in our shop, and a description of our methods of handling them may prove to be of some interest. It is not claimed that our method cannot be beaten, but I think we do very well, considering that no part of the work is done by automatic machines. Our gears give no trouble and are strictly interchangeable.

The gear in question is a twelve pitch miter of 68 teeth, with ⅜" face and a hub 1" long, bored for a 9-16" shaft. After the lumps have been ground off, the castings are drilled and reamed in a drill press. They are placed face down for this operation, consequently the hole is nearly true with the face at the start. Now the turret lathe comes in for its share of the job. The blanks are placed on an expansion stud or chuck, which holds them central, and are driven by another stud on the face plate. While being rotated in this manner, two cuts are taken off the back of the blank. Sometimes it is necessary to take three cuts across before the wheel will run true.

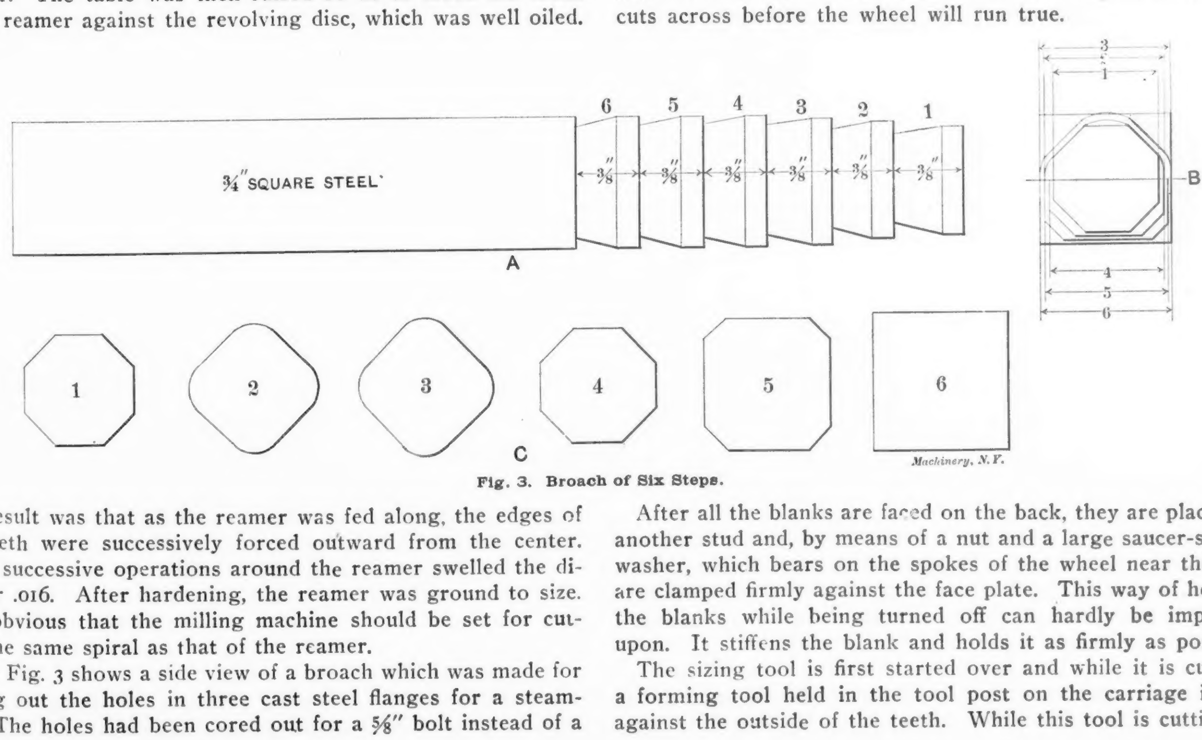


Fig. 3. Broach of Six Steps.

After all the blanks are faced on the back, they are placed on another stud and, by means of a nut and a large saucer-shaped washer, which bears on the spokes of the wheel near the rim, are clamped firmly against the face plate. This way of holding the blanks while being turned off can hardly be improved upon. It stiffens the blank and holds it as firmly as possible.

The sizing tool is first started over and while it is cutting, a forming tool held in the tool post on the carriage is run against the outside of the teeth. While this tool is cutting it-

self free, another tool held in the turret faces the blank to its proper thickness, measured through the rim. The next tool faces the top off the teeth and the last tool trues up the inside end of the teeth. The rim has now been turned all over and with the exception of facing the hubs, the blank is ready to be cut.

The back face of the hub is faced first. We use a counterbore having a tit as long as the distance from the face of the blank to the back face of the hub. The tit "brings up" on the drill press table and forms an excellent stop. The blanks are clamped to the face plate of a Brown & Sharpe index head and the cutter is run across once. By using a special cutter we are enabled to do a very fair job with one cut. After our tools are set we usually run off a hundred or more pieces without having to grind a tool.

All of our lathe tools are made on the inserted cutter plan. The cutters are made of 5-16″ square self-hardening steel. It takes about 8 minutes to turn the rim, drill and ream the hub and face it on both sides. Forty minutes are required to cut the teeth, making 48 minutes for the finished gear.

J. EDWARD BARRETT.

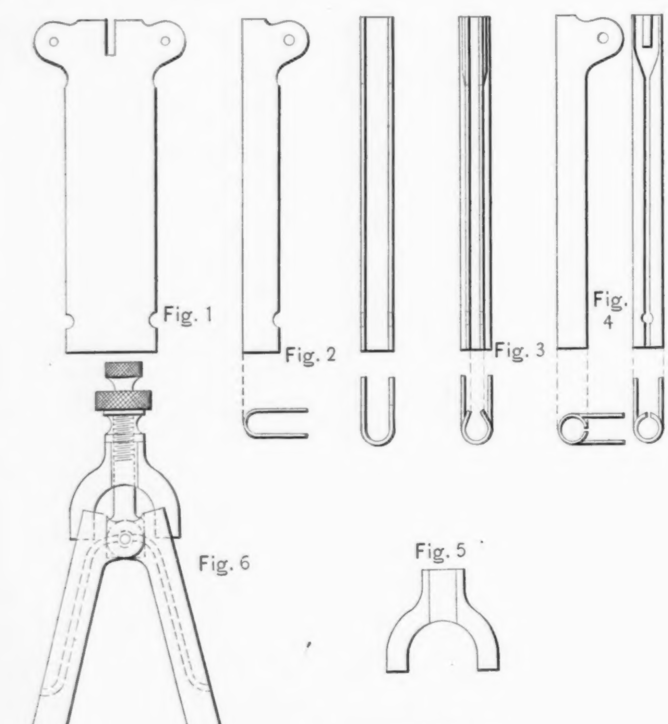
Audubon, N. J.

* * *

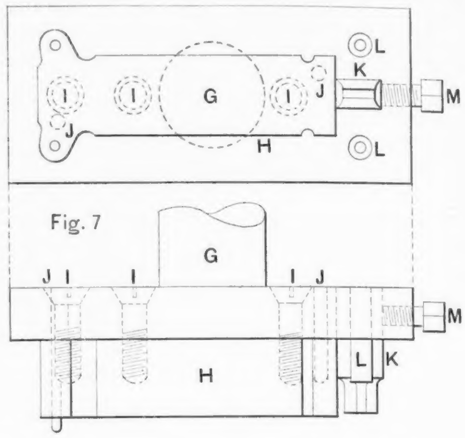
BLANKING, FORMING AND BENDING DIES.

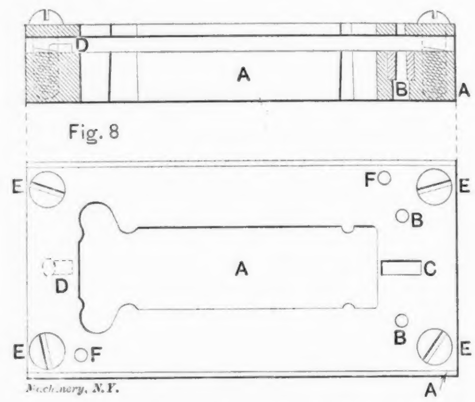
Editor MACHINERY:

The dies to be here described and illustrated were made for piercing, blanking and forming sheet metal to the size and shape of the parts shown in Figs. 4 and 5, used in the compass Fig. 6. The first operation consisted in piercing, notching and blanking the piece shown in Fig. 1, which was done in the gang die illustrated in Figs. 7 and 8. A templet of sheet steel was made, the die was laid out and finished as in Fig. 8, small tool-steel bushings being inserted for the piercing dies B B. The holes for the stripper, dowel pins and gage pins were then "let in" and the die was carefully hardened and drawn, after which the face was ground, the edges being left very sharp for the punch. Then a holder of cast iron was made.



For the blanking punch a piece of flat tool steel 1″ thick by 1½″ wide was planed smooth and square on both sides, one side being polished and clamped to the face of the die, and the outlines of the die were transferred to it with a scriber. It was then shaped down close to these lines, the edges were tapered slightly with a file so that it could enter the die, and it was put into the press and sheared into the die about 1-16″. It was filed down to these lines all around and "let into" the die again, when by repeating the operation a few times, the punch was sheared through the die and it was eased up all around and finished smooth. Three holes I I I for the flat-head screws and two for the dowel pins J J having been drilled through the





holder G, they were transferred to the back of the punch H. Two holes were also drilled in the face of the punch for the pilot pins. The punch was hardened and drawn down to a blue. It was fastened to the face of the holder G and made to enter within the die A its entire length, when the holes were transferred through it for the piercing punches B B and the notching punch C. The holes for the piercing punch were drilled and reamed and the punches made, as shown, 1-16″ shorter than the blanking punch and driven in, shouldering against the face of G. The notching punch was then let into the holder and held by the setscrew M and sheared into the die in the same manner as the blanking punch. The stripper and gage plates were made and fastened and the stop pin D let in, and the die was ready for work. See Fig. 7.

The stock to be punched was entered far enough to allow the ends to be trimmed, the holes pierced, and the center notched, and it was then moved up to the stop pin D. As the punch descended, the pilot pins entered the holes pierced and the piece was blanked, of the shape and size shown in Fig. 1, at each stroke.

The next operation was that of forming the blank into the shape in Fig. 2. N is the die block for bolster O, Fig. 9. The die was made of tool steel finished out to a ⅛″ radius at the bottom. P is the gage plate for locating the blank central; Q Q the screws for holding the same. The punch holder S was made of cast iron, finished as shown and dovetailed to admit the punch R, of tool steel finished on the face by a fly cutter to a radius two thicknesses of metal less than the die. Both die O and punch R were hardened and slightly drawn, leaving the face of each very hard.

The operation of starting to round over the sides, Fig. 3, was done by the punch and die shown in Fig. 10. This punch was made to fit the holder used in the previous operation and the die to fit the bolster before mentioned. The punch is finished out at T to a radius sufficient to take in both sides of the work when it is within the die. The die has a half circle milled through its entire length at U to a ⅛″ radius. The stud V at the back, fastened central within the groove by the two screws Z Z in W, was to locate the work central. These

being set up in the press, the punch descended, closing in the sides of the work, as shown in Fig. 3.

Finishing the bend to a circle and sizing the wings were accomplished by means of the punch, Fig. 11, and the horn, Fig. 12. The punch was finished on the face to a half circle of ⅛" radius. A slot was then milled in the back to admit the sizer B, which was, in turn, milled on each side to allow a thickness of metal between it and the punch. It was fastened by the screws C C. The lower edge of the punch and sizer at this end was slightly rounded to allow the metal to enter easily. All these parts were well polished and hardened. The horn, Fig. 12 was made of stub steel and was two thicknesses of metal less in diameter than the die. A pin was put through one end for the handle. A plate X with a hole in which the horn fitted freely was fastened central to the front end of the die, Fig. 10. The work was placed within the die and the horn extended in the notch in the side of each of the formed legs, acting as a spreader and contractor when the adjustable nut at the top was raised or lowered.

Fastening the punch C within the pad of the punch, Fig. 13, is much more reliable than having the holder and punch all in one piece, as this latter mode necessitates a new holder with each punch and means double work, whereas in the other case it is only necessary to remove the pad and replace with another for a different job.

In hardening irregular dies of this kind, care must be exercised to get an even heat over the entire surface, and when quenching, to dip perfectly straight and move slowly from side to side. Then the die will come out without being changed in shape to any great extent. When a gang die for piercing and blanking, of the type shown in Fig. 8, is made, the insertion of hardened and ground bushings for the piercing dies tends to prolong the life and usefulness of the die, the tendency to shear being, as far as possible, eliminated. If one of the dies should shear, remove it and replace with another of the same kind.

JOSEPH VINCENT.

Brooklyn, N. Y.

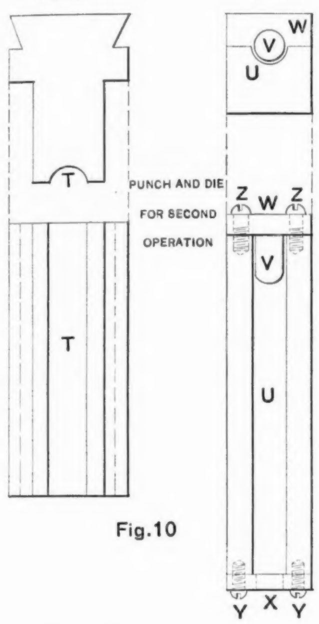


Fig.10

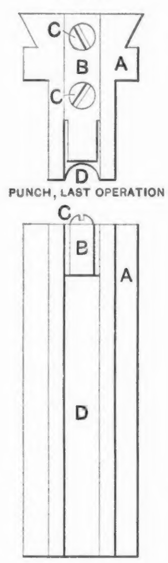


Fig.11

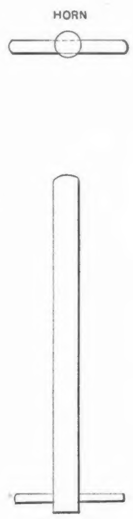


Fig.12

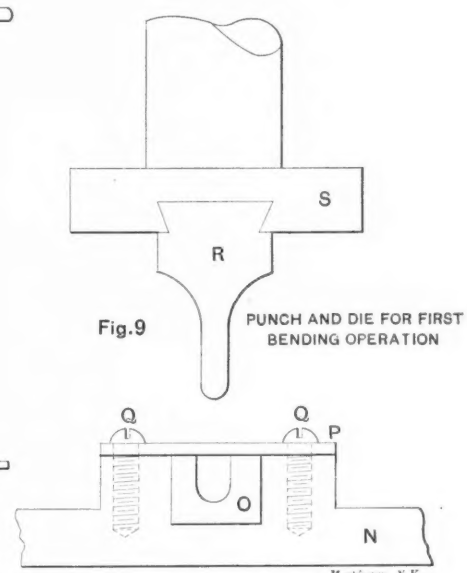


Fig.9

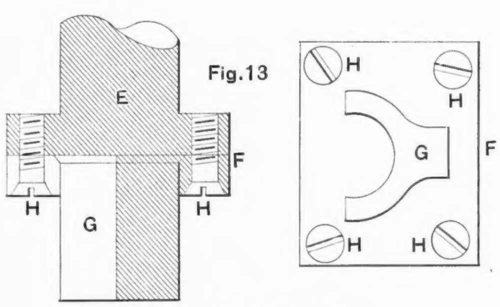


Fig.13

PUNCH FOR FIG.5

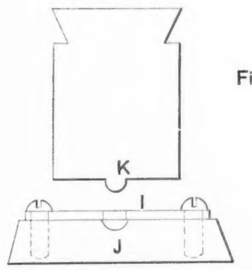


Fig.14

PUNCH AND DIE FOR FORMING FIG.5

slipped through the hole in X, resting within the work, the punch descended, and the two wings entered into the slots in the ends of the punch and were sized, while the half-round groove in the punch formed the rest of the piece around and over the horn in a ¼" circle. When the punch rose, the horn was pulled through the hole X, stripping this work and leaving it in the die, from which it was easily removed by hand. This left the piece formed and finished to the shape and size shown in Fig. 4.

The piece shown in Fig. 5 was produced in two operations. First the punch was blanked with a die of the ordinary blanking type, as described in Figs. 7 and 8. In Fig. 13, E is the holder of cast iron, F the pad of machine steel into which the punch G is "let in" and upset in the back or riveted and fastened to the holder with four flat-head screws H H H H. The forming die for forming the half-round groove in the center of the blank can be seen in Fig. 14. The blank was placed within the gage plate shown at I and the punch K descending, forced it into the die J and formed and flattened it like in Fig. 5. Two of these parts being soldered together left a piece similar to that in Fig. 5 with a 3-16" hole through the center for the screw of the compass; see Fig. 6. The two ends of this piece

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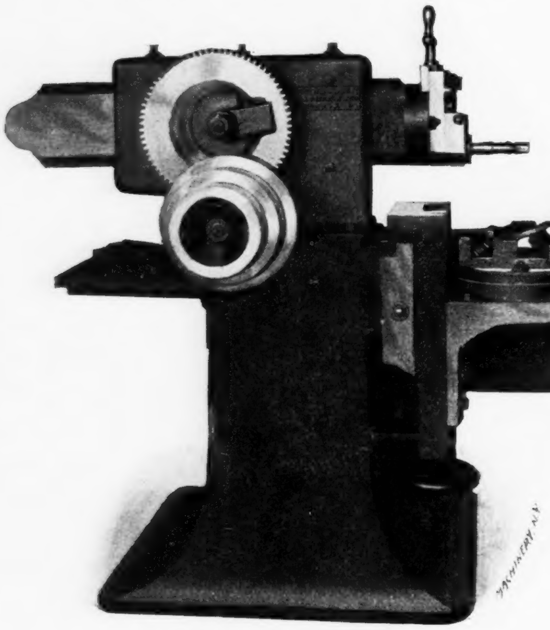
ODD SHAPER DESIGN.

Editor MACHINERY:

In looking through some back numbers of MACHINERY lately I noticed a sketch by a Mr. Hudson of "An Old Shaper Design." This is shown in the November, 1899, number, page 85. I enclose a photograph of a shaper built by the Enterprise Machine Company, Geneva. Several of these were in use at the time the photograph was made (1896) in different shops in Cleveland, Ohio, and from all I could learn were built at about the date Mr. Hudson mentioned in his description. If I read Mr. Hudson's sketch correctly, the shaper ram has a variable stroke, but not properly a quick return. The shaper shown in the photograph most certainly has a quick return. To obtain this the large gear shown is not mounted upon the shaft, but runs upon a boss, or hub, as a bearing, of sufficient size to allow of the shaft being set off the center the amount required

to effect the varying velocity ratio the advance should bear to the return, and yet be able to pass through the boss or bearing of the gear. The shaft has keyed to it the arm shown, and this arm is driven (and by it the shaft) by a pin in the surface of the gear. The pin slides freely in the arm and must so slide for the change of radius during a revolution of the gear. That the shaft is eccentric with relation to the gear is plainly shown in the photograph, by the worn surface upon the gear.



Shaper of Peculiar Design.

Upon the farther side of the machine are a crank and a connecting rod. The crank is slotted and the ram has a T slot in the line of its length. By the use of these slots different positions of the ram, and lengths of stroke may be obtained.

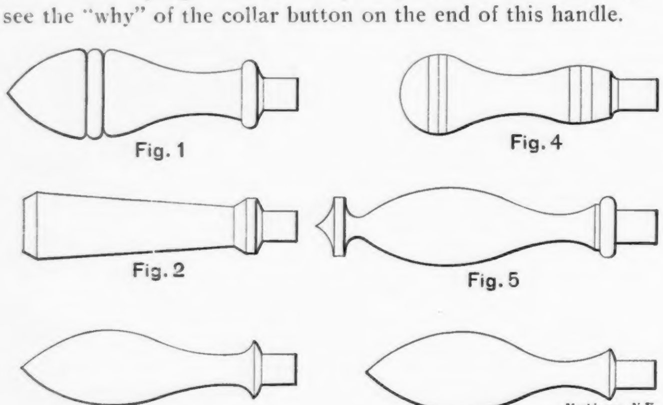
This motion is the well known "Whitworth" quick return as applied to a shaper and is fully illustrated in the second edition of "Elementary Mechanism," by Stahl & Wood, pages 181 and 182. HOWARD P. FAIRFIELD.

* * *

A STUDY IN HANDLES.

Editor MACHINERY:

The different styles of handles shown in the sketch which accompanies this are a few of the many varieties I have run across and jotted down for reference. Nos. 1 and 5 show a taste for fancy shapes in the minds of the designers, the latter being used largely by one of the oldest builders of box lathes in this country—good lathes they are, too—but I never could see the "why" of the collar button on the end of this handle.



No. 2 is angular enough to suit almost any of the few who still prefer square corners and sharp angles to nicely-rounded corners and fillets. No. 4 seems to be a case of not realizing how a handle is grasped and a rather clumsy attempt at being graceful, as a Hibernian would have it. The bulb or largest diameter should be so located as to come in the palm of the hands as in Nos. 3 or 6. These differ but little, although each has advocates. Six has a larger bulb and smaller neck, and is preferred by some.

I have not shown the "loose" or "revolving" handle, which is really a spool on a spindle, as any shape can be put on in this way and the end of the spindle made to conform to the design of the spool.

Where a fellow turns a handle hour after hour, the spool arrangement is all right, for the solid handle does more to tan the palm of the hand into sole leather than almost anything I know of. FRANK C. HUDSON.

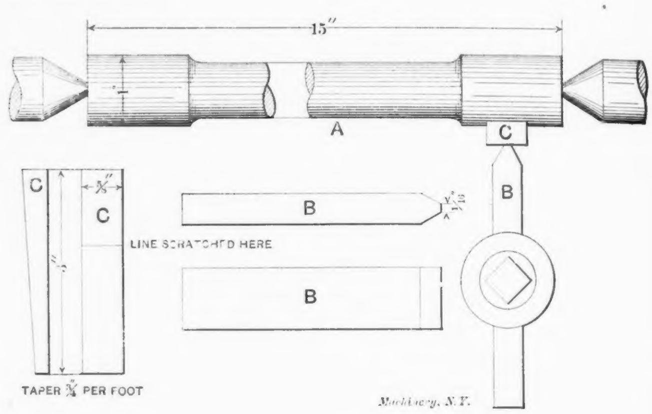
Tombstone, Arizona.

* * *

TO LINE LATHE CENTERS.

Editor MACHINERY:

A few suggestions for setting the centers of lathes dead in line have appeared in the columns of MACHINERY, but a way I have found the surest, cheapest and best, is to have a bar about 15" long turned at both ends to exactly the same size, say about 1" diameter. Also a piece of steel about the size of a lathe tool with one end finished as per sketch and a wedge of any taper planed all over and a line stretched across it, square with the sides.



To use it, place the bar A on the centers, the piece of steel B in the tool post with the finished end toward the bar and the top a little above the center of lathe. The wedge C is then placed between the bar and piece of steel, so that the line will come just at the top of steel piece B. Adjust the tail block until the line on the wedge comes exactly at the top of the piece B when applied at each end of the bar A, when the lathe centers will be dead in line. GEO. L. WARREN.

Wallingford, Conn.

* * *

NEW PRESIDENT, A. S. M. E.

S. T. Wellman was born in 1847, at Wareham, Mass., and a few years later the family moved to Nashua, N. H. Mr. Wellman received his education in Nashua, at the common schools, and at Norwich University, Vt., where he remained for one year. This was followed by a year's apprenticeship in the machine shops of Gage, Warner & Whitney, at Nashua, which young Wellman left in 1864 to join the army, enlisting in the First New Hampshire Heavy Artillery.

After the war Mr. Wellman served in various capacities at the Nashua Iron Company, finally securing the position of draftsman and engineer. It was about this time that he built the first Siemens gas regenerative heating furnace to be used in this country. Shortly after this Mr. Wellman accepted an engagement with Richmond, Potts & Loring, where he remained for three years. During this time he devoted all his leisure moments to the study of the manufacture of steel and built several crucible steel melting furnaces. In 1870 he accepted the position of engineer and assistant at the Nashua Iron Company, and he designed for them an open-hearth steel plant, a bar mill for rolling iron and a three-high plate mill.

In 1873, he settled in Cleveland where he designed and built the new works of the Otis Steel & Iron Company, which acquired a reputation for the excellent quality of steel they turned out. It was while at the Otis Works that Mr Wellman rebuilt one of the furnaces, and put in a basic bottom for the production of basic steel. This was the first basic steel made in the country, but owing to a large demand for their regular

product, the Otis Company decided to discontinue the manufacture of steel by the basic process. In 1889 Mr. Wellman became consulting engineer for the Illinois Steel Co. and designed for them an open hearth steel works and plate mill that are still running. A year later he engaged in a venture which proved unfortunate, but, moving back to Cleveland he organized the Wellman-Seaver Engineering Company, the other members of this firm being his brother, Charles H. Wellman, and John W. Seaver. This company have been very successful and have done business—mostly in connection with steel works —not only in the United States but also in various countries of Europe and in Japan.

Mr. Wellman is the inventor of the Wellman hydraulic crane and of the Wellman open hearth charging machine; also of the Wellman gas producer. He was also director and a large stockholder in the Solid Steel Co., Alliance, O. and in the American Wire Co., Cleveland, O.

* * *

NEW SHOPS OF THE LUNKENHEIMER CO.

The Lunkenheimer Company, manufacturers of brass and iron steam specialties, have completed a new machine shop building at Fairmount, Cincinnati, Ohio. This is a branch factory built to accommodate the iron valve, injector and safety valve departments, and is one of three or four new buildings that the company contemplate erecting in the near future. The present new building is 90 by 170 feet, two stories and basement, and is in the usual gallery style of shop architecture, with traveling crane for the central span. It is equipped with new tools and appliances for manufacturing steam specialties, including testing apparatus that can be used for either air, steam or hydraulic pressure, special boilers designed for 400 pounds pressure having been installed for the purpose. At the opening of the building a reception and dance were held, attended by about 1,000 people. This business was founded by Frederick Lunkenheimer in 1861, and has steadily grown from the start. When all the projected buildings are completed it is believed that it will be one of the most extensive and complete model plants of its kind in existence.

* * *

NEW TOOLS OF THE MONTH.

Under this heading are listed the new machine and small tools that have been brought out during the preceding month. Manufacturers are requested to send brief descriptions of their new tools as they appear, for use in this column.

MICROMETER HEADS FOR SPECIAL GAGES.

Considerable use is now being made of micrometer heads on special gages of various kinds. At the beginning, and in many cases still, these heads were obtained by cutting off the yoke

Fig. 1. Special Micrometer Gage.

of a complete micrometer caliper, but they are now being supplied by J. T. Slocomb & Co., Providence, R. I., without the yoke, making a straight cylindrical piece containing the screw and graduating mechanism. These heads do not differ from the head of a complete caliper except that they have a turned cylindrical seat for insertion in any special piece or gage desired. The head may either be attached to the gage by soft solder or by clamping.

In Fig. 1 is shown one of these heads applied to a stop designed to be fitted to the ways of an engine lathe. This is used for adjusting the lathe carriage along the ways and is very convenient for a light tool-makers' lathe. The head may be attached to various kinds of testing tools, such as gages to be inserted in a drill-press spindle to test the truth of the table, in holders to be supported by the lathe or planer tool post, in special jigs for determining the accuracy of bevel gear blanks, etc.

NEW UPRIGHT TAPPER.

An upright tapper having two, three, or four spindles, as desired, has been brought out by the Geo. Burnham Company, 21 Hermon St., Worcester, Mass. It is especially adapted to odd lots of work, and the change from one size of tap or nut to another can be made very quickly. The capacity of these tappers is for ½-inch nuts or under, and the manufacturers write us that with the three-spindle machine, such as is shown in the engraving, 8,000 ⅜-inch hexagon nuts can be tapped in ten hours.

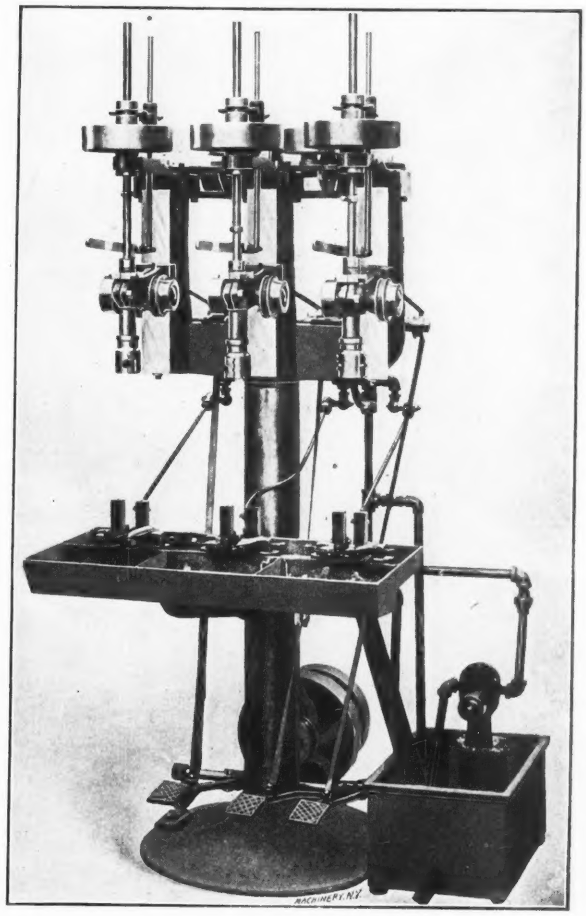


Fig. 2. Three-spindle Tapper.

The spindles of the machine are independent. Each can be stopped instantly without stopping the rest, and all are operated by foot. Each spindle is provided with a universal chuck for holding the taps, which keeps them in proper place until filled with nuts.

The holder for the nut is so arranged that the tap does not have to run entirely through the nut before another may be started, as the holder is provided with guides to carry the nut off the thread, thus avoiding the danger of breaking the taps. This also makes a machine of few spindles equal in capacity to a larger machine not having this feature, since it is not necessary to wait for the nuts to travel to the upper end of the tap before starting a new nut.

Each machine is provided with an oil pump and tank, and oil can be plentifully used, so that the tap is well lubricated, and the chips are washed away, thus insuring the nuts being tapped square with the bottom.

THIRTY-TWO INCH VERTICAL TURRET MACHINE.

The illustration in Fig. 3 shows a vertical turret machine with revolving spindles, made by A. D. Quint, Hartford, Conn. It is designed for boring, drilling, tapping, etc., and is made with sliding head, power and hand feed, automatic stop and quick return. It is distinguished from other turret machines, in that the cutting tools revolve instead of the work, thus not restricting the work operated on to a size that will revolve on the table. The machine will finish a hole at one setting of the work, which insures accuracy with rapidity of operation, regardless of the size or irregularity of the piece operated on.

The base, column, stand and table are of the well-known type of upright drill. The sliding head on the column is balanced by a weight, and carries the feed mechanism, the locking index, and the gearing for the transmission of motion from a vertical shaft to the revolving tool spindle. On the sliding head is mounted a four-spindle turret, free to rotate on the head. All the spindles in the turret are indexed to the same point when the spindle is in position for work. Only the spindle in use

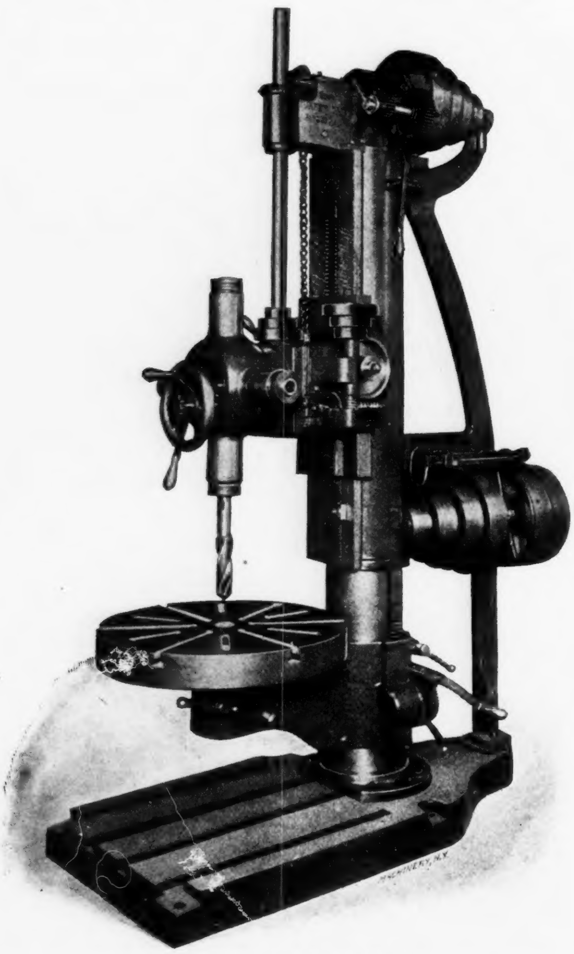


Fig. 3. Vertical Turret Drill.

revolves. Any spindle wanted may be swung into position, without stopping the machine, by means of a lever shown on the front of the turret, which when moved 45 degrees to the right, will release the index bolt. When the turret is revolved to the spindle wanted, the lever will automatically lock the turret with the spindle running and in position. The hand feed is operated by means of the hand wheel in front of the turret. The power feed has three changes, and is operated by the belt and cone pulleys on the sliding head. The feed is started and stopped by the knob in front of the hand wheel, or it can be set to stop automatically for any depth of hole up to 28 inches. The quick return of head is by the pilot wheel on the left hand side of the head, which operates a pinion in mesh with the rack in face of the column.

The clutch for connecting and disconnecting the back gears may be thrown in or out, while the tool is running, and any tapping device may be used. The spindles are two inches in diameter, distance from center of spindle to face of post, 16¼ inches; distance from spindle to base plate, 54 inches; distance from spindle to table, 36 inches; automatic feed, 28 inches.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Cincinnati Planer Co., Cincinnati, O. Illustrated catalogue of planers ranging in size from a 24" planer to a 56" planer with two heads on the cross rail and two side heads.

Joseph Dixon Crucible Co., Jersey City, N. J. An attractive circular entitled, "Where the New Century Will Really Begin." It deals in an interesting manner with the Dixon pencils.

New Doty Mfg. Co., Janesville, Wis. Catalogue "D" of punches and shears. Various styles are illustrated and the sizes range from the heaviest tools needed for heavy work to those of small dimensions.

B. F. Sturtevant Co., Boston, Mass. Catalogue No. 103 of the Sturtevant engines for electric light plants. These engines are both vertical and horizontal, and they are made of the marine and of the enclosed types. The catalogue is fully illustrated.

Philadelphia Pneumatic Tool Co., Philadelphia, Pa. Circulars describing the different pneumatic tools which they make, including a rotary drill, pneumatic hammers for chipping and calking, riveting hammer and a pneumatic sand rammer for foundry use.

Becker-Brainard Milling Machine Co., Hyde Park Mass. Catalogue No. 51 of horizontal spindle milling machines, automatic gear cutters, milling cutters and attachments. This catalogue is pocket size and we understand that one is soon to be issued describing the vertical spindle milling machines made by this company.

Landis Tool Co., Waynesboro, Pa. Illustrated pamphlet upon the construction and use of universal grinding machines as made by this company. The pamphlet describes completely the various styles and sizes of plain and universal grinding machines which this company make, there being numerous detail drawings showing the construction of the different parts. In addition, there is much information upon the use of the grinding machine, its capabilities, with hints for performing different classes of work and suggestions about emery wheels.

MANUFACTURERS' NOTES.

The Garry Iron & Steel Roofing Co., Coe and Lake Sts., Cleveland, O., inform us that they have just made shipment to China of a large pneumatic crane and also car jacks for use on the Eastern Chinese Railway, and they also have orders for 12 cranes to be shipped to Europe.

The Smooth-On Mfg. Co., 547 Communipaw Ave., Jersey City, N. J., announce that they have issued a circular giving a description of and directions for using Smooth-On compound, one of their iron cements, and that it will be sent to the address of any person interested.

The W. P. Davis Machine Co., Rochester, N. Y., wish to announce that they are putting in a catalogue case with the intention of getting all the latest catalogues on machinery and tools, as well as supplies in the line they handle. They will be pleased to receive catalogues from all the manufacturers of the above-named articles.

New Process Twist Drill Co., Taunton, Mass. Catalogue illustrating and describing the large assortment of hot-forged twist drills made by this company. Also circular calling attention to their four groove chucking reamer. This company announce that their catalogue for 1901 is now ready and will be mailed free of charge upon application.

The Newton Machine Tool Works, Philadelphia, are now installed in their enlarged works, and with the increased tools which they will receive will have fully three times the capacity of their old works. They report the prospects for business are very good, especially in the line of heavy and portable tools. They are now designing a very large milling machine for the German Government which will weigh about 150,000 pounds.

The Sprague Electric Company, 527 W. 34th St., New York, report that they have been obliged to increase the floor space in the New York office. The New York factory is devoted exclusively to the manufacture of various lines of interior conduit and appliances. The company operate a still larger plant in Bloomfield, N. J., where are manufactured all the light and power apparatus, such as generators, motors, fans, elevators, hoists, etc.

The Bullock Electric Mfg. Co. inform us that the large addition to their machine shop and the building provided for their brass foundry, boxing and brass polishing departments are nearing completion. This company expect that the capacity of the works will then be nearly doubled. They have recently received large contracts from home and abroad, and say that the outlook for business during 1901 is very good. Their recently-issued bulletin No. 37 gives a list of purchasers of Bullock apparatus, and shows numerous views in the works and the various type of machines now manufactured.